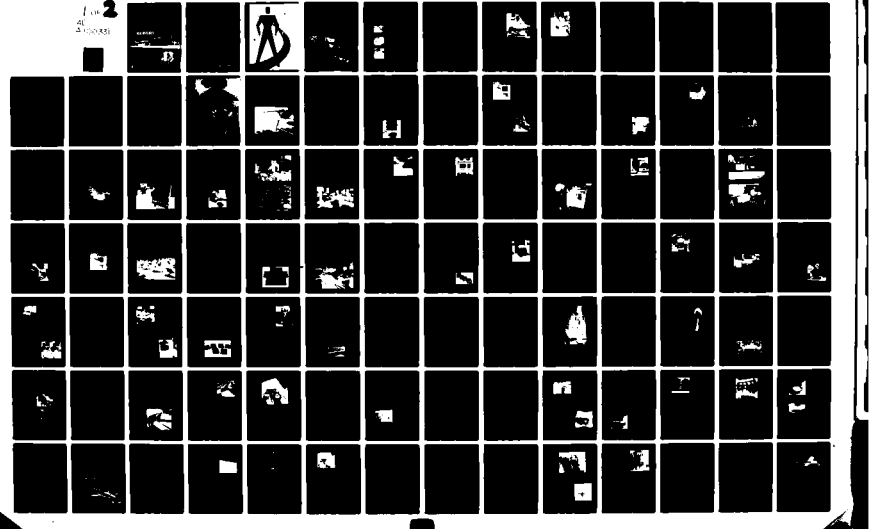
AD-A100 331 AIR FORCE HUMAN RESOURCES LAB BROOKS AFB TX F/G 5/9
AFHRL ANNUAL REPORT FY 80.(U)
1980

UNCLASSIFIED NL



LEVEL II 0

AFHRL Annual REPORT

FY 80

AF HUMAN RESOURCES LABORATORY

AIR FORCE HUMAN RESOURCES LABORATORY

A Designated Organizational Element of the Air Force Systems Command

RONALD W. TERRY
Colonel, USAF
Commander

EARL A. ALLUISI
Chief Scientist

ACKNOWLEDGEMENTS

Prepared by the Applications and Liaison Office (AFHRL/AZ) on the basis of the research and development efforts of the AFHRL scientists and associated contractors, with the assistance of numerous individuals from the operating divisions and the headquarters staff. Special appreciation is due Dr. Ruth Buescher who organized and coordinated the report and Mr. Sharon H. Tice (USAF School of Aerospace Medicine, Medical Illustrations Section) who provided many of the graphics and illustrations.

NOTICES

DISTRIBUTION: Approved for public release, distribution unlimited. Primary distribution of this report has been made by AFHRL. Please address correspondence concerning distribution of reports to AFHRL/AZ, Brooks AFB, TX 78235.

CONTACTS: A directory of AFHRL headquarters staff personnel and division chiefs is provided on the inside back cover. Points of contact are also given for each technical achievement and for the ongoing research and development program.

NOTE: The findings in this report are not to be construed as an official Department of the Air Force position unless so designated by other authorized documents.

MISSION

The Air Force Human Resources Laboratory (AFHRL), with headquarters at Brooks AFB, Texas, is one of six laboratories reporting directly to Air Force Systems Command (AFSC). AFHRL plans and executes the USAF exploratory and advanced development programs in manpower and personnel, education and training, simulation and training devices, logistics and group aspects of human factors engineering. The Laboratory also develops demonstrations of advanced simulation and training delivery system hardware and software technologies and provides technical consultation and support of analyses, studies, research and development planning and conceptual study efforts. Laboratory research also supports exploratory, advanced, and engineering development projects, equipment procurements, modifications, test and evaluation programs, and system acquisition programs where the intended end product has human performance as an integral component.

The AFHRL mission is broader than those of most other technology laboratories of AFSC. The hardware laboratories are almost entirely concerned with technological development, *but hardware* technology development is only one of the responsibilities of AFHRL. Of equal importance in the AFHRL mission is development of information for uses in making management and policy decisions on personnel selection and training. Timely information to decision makers is extremely important as they adjust to changing conditions such as a drawdown or buildup in personnel, changes in attitudes, and social problems. Human resources technology is particularly important because the largest single item in the Department of Defense budget is the cost of personnel and the associated costs of training and administratively supporting the personnel force. Consequently, there is a greater possibility for cost savings in the human resources area than in all other technology areas combined. Savings resulting from advanced human resources technology, such as an improved training method which reduces the length of a training course or the development of a means of increasing the utilization of personnel, tend to be cumulative over the years. The pyramiding of cost benefits from research in human resources research programs over the years produces disproportionate returns from the modest investment in such research. Only people can formulate, implement, and modify the objectives and strategy that will insure the Air Force maintains aerospace superiority over any adversary. Thus, it is important that the human resources research program maintains strong thrusts in that direction.

AFHRL ANNUAL REPORT FY 80
CONTENTS

The military mind always imagines
that the next war
will be on the same lines as the last.
That never has been the case
and never will be.

Marshal F. Foch

MESSAGE FROM THE COMMANDER

Col Ronald W. Terry

A major function of the Air Force Human Resources Laboratory (AFHRL), like that of all Department of Defense (DoD) laboratories, is to develop alternative new technologies that will provide options for our military leaders when next they face combat. In this sense, the DoD laboratories are collectively the "keepers" and expanders of the technology base as it relates to national defense. AFHRL is the "keeper" and expander of the Defense Training and Personnel Systems technology base as it relates more specifically to the Air Force.

AFHRL was established, essentially in its present form and scope, in July 1968. After the first decade of the Laboratory's current life cycle, it seemed appropriate to assess our accomplishments and to reassess our directions and goals. We began to do this in July 1978.

As a result of this assessment, and of other studies conducted by groups such as the Defense Science Board and the Air Force Scientific Advisory Board, a restructuring of the R&D program was mandated during 1979. As the reformulated program evolved to completion during FY 80, the need for a realignment of the Laboratory's resources became apparent, and that need was also met during FY 80.

Although all of our management goals have not yet been met, many have, and substantial progress has been made towards the others. We now have a viable R&D program, the goals and approaches of which can be articulated to both the scientific and military-user communities. Resources have been reallocated to achieve a better balance against program needs.

We all owe a debt of gratitude to the many scientific and engineering personnel within the Laboratory, and to numerous persons external to the Laboratory, who assisted in our assessment, program restructuring, and subsequent realignment of resources. We thank you all.

RONALD W. TERRY, Colonel, USAF
Commander

CHIEF SCIENTIST'S REPORT

Dr. Earl A. Alluisi

During FY 80, The Laboratory completed a major program restructuring and realignment of resources. The *main body of this report* presents the technical achievements and ongoing research and development (R&D) in terms of *the restructured program*. The final sections present details of the Laboratory's organization and resources as realigned to fit the new program structure.

Four efforts converged during the program restructuring:

1. A ***matrix-management approach*** was taken to permit reallocation of resources from the discipline-oriented categories in which budgetary elements are reported annually to the Congress (i.e., Personnel and Manpower; *Education and Training*; *Simulation* and Training Devices; and Human Factors) to the mission or objectives-oriented thrust areas of the Laboratory's *R&D* program (i.e., Weapon Systems Logistics, Maintenance, and Technical Training; Manpower and Force Management; and Air *Combat Tactics and Training*).

2. ***Laboratory R&D thrusts*** were developed in each of *the thrust areas as integrated* R&D *efforts* leading to concrete objectives.

3. ***R&D architectures***, roadmaps, or research agendas were prepared to represent in comprehensible forms the overall approaches being employed to achieve the R&D objectives.

4. A ***Laboratory Operations Center (LOC)*** was designed and implementation started to permit quantitative analysis, administration, and management of *the program with no increases in, but rather with relief of* the administrative demands made on the scientists and engineers who conduct and monitor *the* Laboratory's work.

First iterations of the program management matrix, the R&D thrusts, and the thrust and subthrust architectures were completed. The LOC was established and carried to about 75 percent completion during FY 80. The articulation of a "requirements architecture," to show where the Laboratory's program is addressing Air Force requirements and where it is not, was also begun but not completed.

Efforts in all these areas are expected to continue into the years ahead as means of ensuring that the ongoing R&D program is adaptive, relevant, beneficial, and cost effective, but most importantly, that it is aimed at increasing the probability and ease of USAF combat success.

Technical Evaluations. There were many management reviews of the Laboratory during FY 80, as there are every year. However, it became apparent during the course of the program assessment that there had been insufficient technical reviews or assessments of the quality of the program. As a result, a Research Advisory Panel (RAP), consisting of three scientists of international repute in the substantive area from outside the Department of Defense, was established for each of the three thrust areas. The first RAP review was tried with the Air Combat Tactics and Training R&D thrust area during FY 80. The result was so helpful in the further development of that thrust area, RAPs were then mandated for the other two areas. In addition, the AFHRL Technical Advisory Board (TAB), consisting of the Technical Directors of the three operating R&D Divisions, the Chief Scientist as chairman, and a secretary, was charged with the technical review and assessment of the quality of the Laboratory's R&D program. The TAB is assisted in their technical reviews not only by the RAPs, but also by External Reviewers (ERs) who are counterparts from the corresponding laboratories of the other Services. Although such technical reviews and assessments were begun during FY 80, the first complete round will occur during FY 81.

Technical Status of the Weapon Systems Logistics, Maintenance, and Technical Training Thrust Area. The logistics R&D mission area is a newly expanded one for the Laboratory. The thrust in Weapon Systems Logistics is evolving from sound bases of manpower and human resource factors in design and weapon systems acquisition. Similarly, the work in Technical and Maintenance Training is based on prior R&D in maintenance aiding and performance enhancement, but the expansion of the area of concern and its integration with the R&D on maintenance training simulation and computer aided instruction in technical training are new. The Crew, Group, Team, and Unit (CGTU) Performance and Training thrust is also an emerging effort—and one that is employing the command and control system as an environment (or "carrier signal") in which to begin, with the intent of moving to the maintenance performance areas as soon as practicable. The needs in this thrust area are clear enough—to provide a technology base for the delivery of skilled personnel and materiel to the operating Major Commands of the Air Force. Especially notable is the attention given throughout this thrust area to issues of applicability to combat operations. The program in this area is in too elementary a form to permit anything other than an assessment of its potential and its promised quality, both of which are respectably high as based on past performances.

Technical Status of the Manpower and Force Management Thrust Area. The thrust in development of an Air Force Civilian Appraisal System to meet the requirements of the Civil Service Reform Act of 1978 is winding down and will be completed by October 1981. Constraints imposed by the operating system have limited the effort to less of an R&D-based product than had been initially planned. The thrust to develop Enlisted and Officer Force Acquisition and Distribution Systems represents the major portion of efforts in this area. Although the objective is quite responsive to Air Force personnel system operations in the current, or peacetime, environment, there is a clear need to expand the scope to include issues of optimization for combat operations. The thrust towards a Enlisted and Officer Force Management System, which is just now emerging, will include increased attention to issues of applicability to combat operations. On the whole, this thrust area, which includes in its mission the development of new technology for selection, classification, training, assignment, retraining, reassignment, and force management generally, is based on technology most in need of rejuvenation. The technology base has had very little real expansion since World War II, but considerable refinement. Expansion is now feasible, if coordinate technology advancements in other areas (such as computers) are employed, not merely to refine what has been done in the past, but rather to change what has been done into something better—more valid and with greater applicability.

Technical Status of the Air Combat Tactics and Training Thrust Area. Many of the personnel and programmatic problems in this thrust area were solved during FY 80 by the functional transfer of the Simulation Techniques Branch from the former Advanced Systems Division at Wright-Patterson AFB, Ohio, to the newly created Operations Training Division at Williams AFB, Arizona. With this transfer, all the engineering R&D on flight simulation within the Laboratory was integrated into a single thrust on Engagement Simulation Technology. Thus, component developments are tested on the Advanced Simulator for Pilot Training (ASPT) and evaluated for utility in behavioral experiments. The behavioral side of the thrust area is represented in the Air Combat Training thrust. Although it should logically be the driver of the engineering program, it has in fact been driven, in large measure because of an imbalance in resources between the two—an imbalance that will be corrected along the lines begun during FY 80. By FY 82 or FY 83, the resource balance should have shifted with the greater proportion in the behavioral side of the program where the requirements are now considerably greater than those on the engineering side. The thrust in Operational Unit Training is emerging, with essentially no efforts having been expended on it during FY 80.

General Comments. An annual report provides a static picture—a point in time—of the very dynamic program which is, in the last analysis, the very substance of the Laboratory. The directions of the program are at least as important as its current status. And here the evaluation can be clear: The direction is proper—to develop and apply the technology base in order to increase the probability and ease of combat success.

AFHRL THRUST AREAS

General Description

The Laboratory's R&D program is currently divided among three thrust areas: (a) Weapon Systems Logistics, Maintenance, and Technical Training, (b) Manpower and Force Management, and (c) Air Combat Tactics and Training. Each thrust area is functionally managed through a Laboratory R&D Division: (a) the Logistics and Technical Training Division (AFHRL/LR), (b) the Manpower and Personnel Division (AFHRL/MO), and (c) the Operations Training Division (AFHRL/OT), respectively.

The thrusts and subthrusts within each of these thrust areas have been defined, with certain of them still in the "emerging" stage. The "architectures" that are employed to describe all three levels—thrust area, thrust, and subthrust—are dynamic rather than static. They may be expected to change somewhat from year to year to show validly the identification of both near-term and long-term objectives, the planned transfer of thrust component technologies where appropriate, and the approach employed to develop the technologies and systems desired for enhancement of combat success.

General descriptions of the thrust areas are given below and on subsequent pages. Diagrams portraying the respective thrust areas are also provided. These diagrams are employed with highlighting in later sections to aid in identification of the parts of the R&D program being reported.

Weapon Systems Logistics, Maintenance, and Technical Training Thrust Area

The prime objective of this thrust area is to provide the technology to ensure effective and efficient support of Air Force operations. This support includes logistics, materiel and human resources. Special attention is devoted to maintenance. Also included as an objective is the technology to ensure effective team performance in ground-based systems. The area consists of three interrelated thrusts: (a) Weapon Systems Logistics, (b) Technical and Maintenance Training, and (c) Crew, Group, Team, and Unit Performance and Training.

The first thrust pertains especially to the logistics aspects of Air Force weapon systems. It includes three subthrusts. One subthrust is to develop the technology for the integrated logistics system of a weapon system. A second subthrust is to provide the technology to ensure effective logistics support for combat maintenance. The third subthrust is to improve the performance of maintenance.

The second thrust pertains to technical training, with special attention to training maintenance personnel. The subthrusts, in turn, concern simulators for maintenance training, a system for making major decisions about the management of training, on-the-job training, and the extensive use in the Air Force of the available technology for computer-based instructional systems.

The third thrust is aimed at improving the performance of non-flying crews, groups, teams and units. Special attention is being given to teams involved in command, control, and communication systems because of the pressing current needs for improvements in those systems.

R&D investment in the area of these thrusts promises unusually high payoff. The potential to reduce cost and increase weapon system supportability is high because this area of technology is quite underdeveloped and initial big-step improvements can be made. The thrusts, as well as most of their sub-thrusts, have been the subject of unusual high-level interest. Special scientific and operational study groups have stressed the need for increased R&D in the thrust areas. Requirements have been indicated in recent studies and guidance from HQ USAF and the Department of Defense, and in Logistics Needs from the Air Force Logistics Command.

WEAPON SYSTEMS LOGISTICS, MAINTENANCE, AND TECHNICAL TRAINING THRUST AREA

Prior R&D — **FY80 — Thrusts Projections Over Future Years** →

- o Life Cycle Costing
- o Logistics Support Analysis
- o Diagnostic Tests of System In Test Equipment
- o Coordinated Log Resource Plan

→ Logistics Factors in Design and Acquisition Logistics Technology

- o Logistics Composite Model
- o Repair of Battle Damage
- o Maintain Under CB Warfare
- o Combat Maintenance
- o Logistics Readiness

→ Logistics Support & Combat Effective Maintenance System

- o Aids to Maintenance Performance
- o Personnel & Training Impact Maintenance
- o Readiness of Maintenance Units

→ Maintenance Performance System

- o Specification for Maintenance Simulators
- o Fidelity Requirements for Simulators

→ Maintenance Training Simulator Systems

- o OJT Evaluation Systems
- o OJT Management Systems

→ OJT Evaluation and Management Systems

- o Computer Based Training Management Systems
- o Resource Scheduling Systems

→ CBI Technology Transfer

- o Team Training and Evaluation
- o Human Resources in C^3 Systems
- o Aiding Decision Making in C^2 Systems

→ Crew, Group, Team, Unit Performance and Training (Emerging Thrust)

→ Weapon Systems Logistics Processes, Methods, and Data

→ Performance Validated Individual Training Systems

→ Performance Validated Team Training and Performance Aids

→ New Technology For Weapon Systems Logistics Processes, Methods, Data, Training, and Performance Measurement

Note:

CBI — Computer-Based Instruction
C^2 — Command and Control
CB — Chemical Biological
OJT — On-the-Job-Training

Manpower and Force Management Thrust Area

The primary objectives of this thrust area are (a) to develop management tools, procedures, and associated technologies to ensure the more effective use of personnel resources by improving selection methodologies and establishing appropriate job requirements, (b) to structure and maintain a workforce with the required aptitudes and experience to meet operational commitments in both peacetime and wartime environments, and (c) to establish a comprehensive skills management program to improve personnel utilization and productivity. The area consists of two ongoing thrusts and one emerging thrust: (a) Civilian Appraisal System, (b) Enlisted and Officer Force Acquisition and Distribution Systems, and (c) Enlisted and Officer Force Management System (thrust still emerging).

The Civilian Appraisal System thrust is a near-term effort to develop an operational system to fulfill the requirements of the 1978 Civil Service Reform Act.

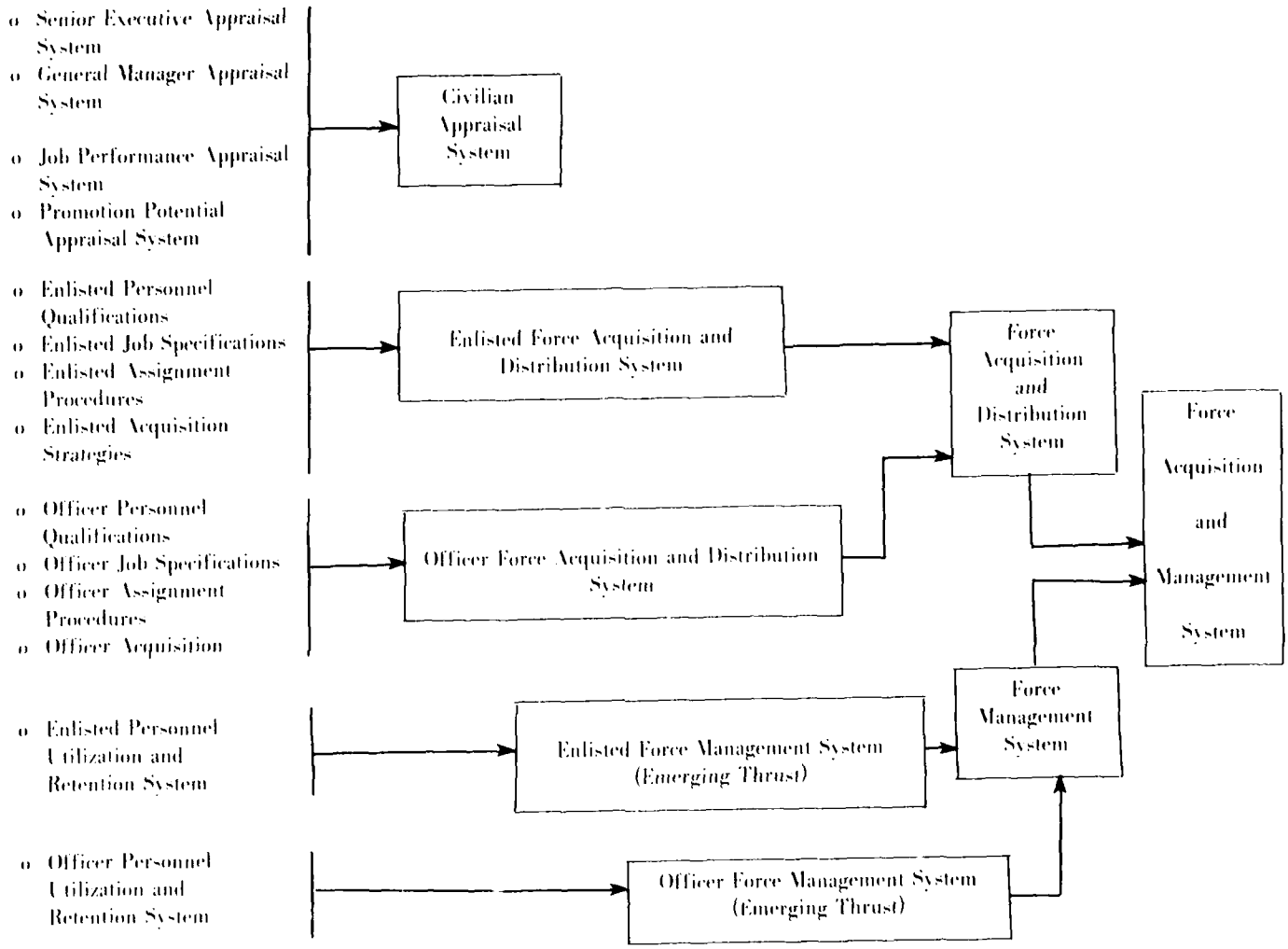
Research from the Force Acquisition and Distribution Systems thrust will provide a basis for personnel decisions in the initial procurement, selection and assignment of Air Force personnel. Devices developed include methodologies (a) for the procurement and selection of personnel motivated for Air Force service, (b) for the assignment of personnel to jobs compatible with their aptitudes, interests and experience, and (c) for enhancement of career motivation. The development of computer-assisted Personnel Acquisition and Distribution Systems will provide the Air Force with a variety of alternatives to force-manning in the light of a diminishing manpower supply and will help to ensure that the available pool of talent is optimally used and that resources are allocated to maximize the return on personnel investment.

Research to develop an Enlisted and Officer Force Management System is designed to provide Air Force managers with devices, models and strategies to improve evaluation of job performance, career motivation, retention, job satisfaction, and individual/unit productivity, and to establish effective reenlistment/career assignment programs. The decreasing applicant pool of service-eligible personnel makes the effective use and retention of in-service personnel critical during the 1980s. Also, an occupational research data bank containing various occupational input sources provides ready access of an extensive data base for the design and conduct of R&D in support of the manpower and personnel system.

Immediate benefits to be accrued from these thrusts are technologies that (a) improve the efficiency and economy of personnel procurement, (b) ensure optimal classification and assignment of both first-term and career personnel, (c) provide an accurate evaluation of individuals best qualified for Air Force service, (d) facilitate movement between specialties to correct manning imbalances, and (e) provide prototype system for performance assessment of Air Force civilians. Longer term benefits include (a) improving the capability to match an individual's abilities with Air Force job requirements more accurately, (b) increasing testing flexibility through perceptual/motor and computer-managed testing, (c) reducing training costs as a function of reduced attrition, (d) identifying and forecasting potential critical problems of manpower supply in time to propose remedial action, (e) improving job satisfaction, productivity, and retention, and (f) developing on-the-job performance criteria for validation of selection devices.

MANPOWER AND FORCE MANAGEMENT THRUST AREA

Prior R&D — **FY80 — Thrusts Projections Over Future Years** ⟶



Air Combat Tactics and Training Thrust Area

The prime objective of this thrust area is to identify and demonstrate more cost-effective training strategies and training equipment capabilities for use in maintaining or improving the combat effectiveness of USAF aircrew members. It addresses Air Force goals to provide trained aircrews who can effectively operate aerospace vehicles under both training and combat conditions. The area consists of three thrusts: (a) Air Combat Training, (b) Engagement Simulation Technology and (c) Operational Unit Training. The first and third thrusts, Air Combat Training and Operational Unit Training, involve behavioral training research. The second thrust, Engagement Simulation Technology, is basically simulator support and engineering technology development.

Most training R&D is accomplished under the Air Combat Training thrust. Its objective is to provide a technology base for training high-level crewmember skills in simulated combat environments. It is best understood as an extension of past work using the Advanced Simulator for Pilot Training (ASPT). That R&D explored the development of basic flying skills, such as transition, instruments, and air-to-surface ordnance delivery on a conventional range. The present R&D is being extended to the development of training strategies and equipment requirements for use in ordnance delivery on tactical targets using wartime tactics in a realistically modeled combat arena. The rate and scope of this expansion will be largely dependent on the availability of new engineering technology developed under the Engagement Simulation Technology thrust. Efforts within the Air Combat Training thrust will address all major facets of air combat training. Four subthrusts include Tactics Training and Flying Skill Maintenance, Measurement of Aircrew Training Readiness, Visual and Force Cuing Technology, and Aircrew Training Technology Applications.

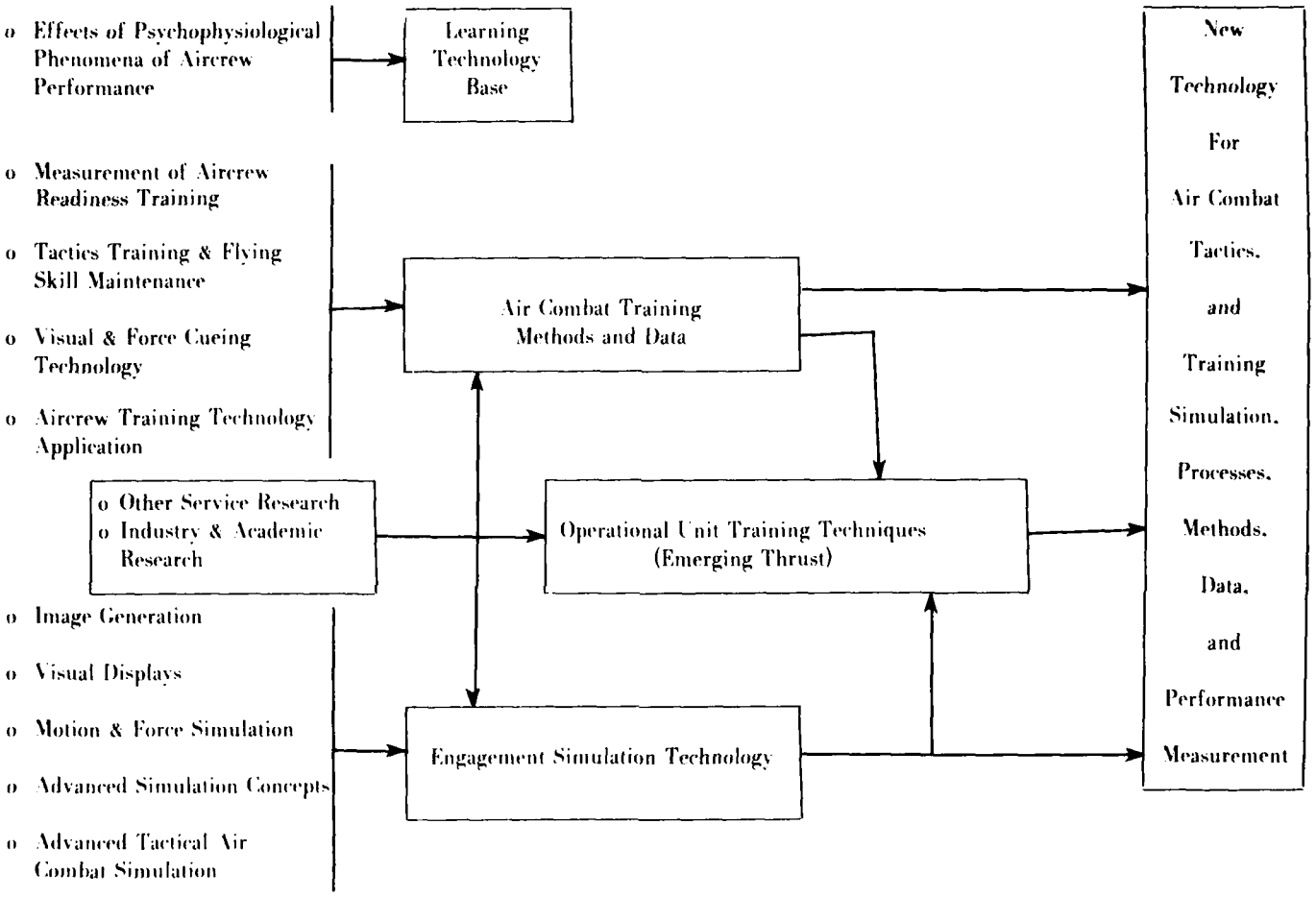
The Engagement Simulation Technology thrust is primarily engineering R&D oriented toward the development of algorithms, software, and hardware techniques that support the operations training R&D. Attention is focused on the development of mission simulator components and subsystems that will provide greater training capability at a lower cost. It involves subthrusts in Image Generation, Visual Displays, Motion and Force Simulation, Advanced Simulator Concepts, and Advanced Tactical Air Combat Simulation.

The third thrust, Operational Unit Training, is an emerging thrust that will have as its objective the integration of operationally applicable findings concerning pilot training into ongoing unit training programs. The result will be improved efficiency in training and increased combat readiness capabilities. This effort will be formally initiated in FY 82.

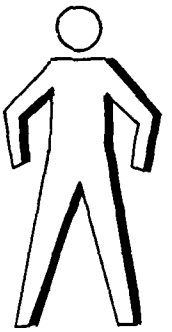
The development of new technology and the demonstration of technological advancements in flying training courses are directed at producing the required skilled aircrews at optimum cost. In the near term (FY 81-82), this R&D area will provide the equipment and training capabilities necessary to teach basic combat skills and tactics. In the longer term (FY 83 on), the R&D will address training in those combat skills required to be successful in specific combat areas and to function effectively as a member of a coordinated combat team. These inter-related benefits will lead to increased mission readiness for operational crews and to the ultimate goal of success in combat.

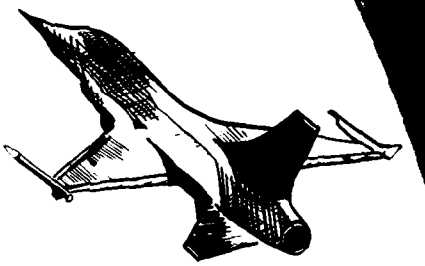
AIR COMBAT TACTICS AND TRAINING THRUST AREA

Prior R&D — **FY80 — Thrusts Projections Over Future Years** ⟶



COMBAT SUCCESS





MANPOWER & FORCE MANAGEMENT RDT & E

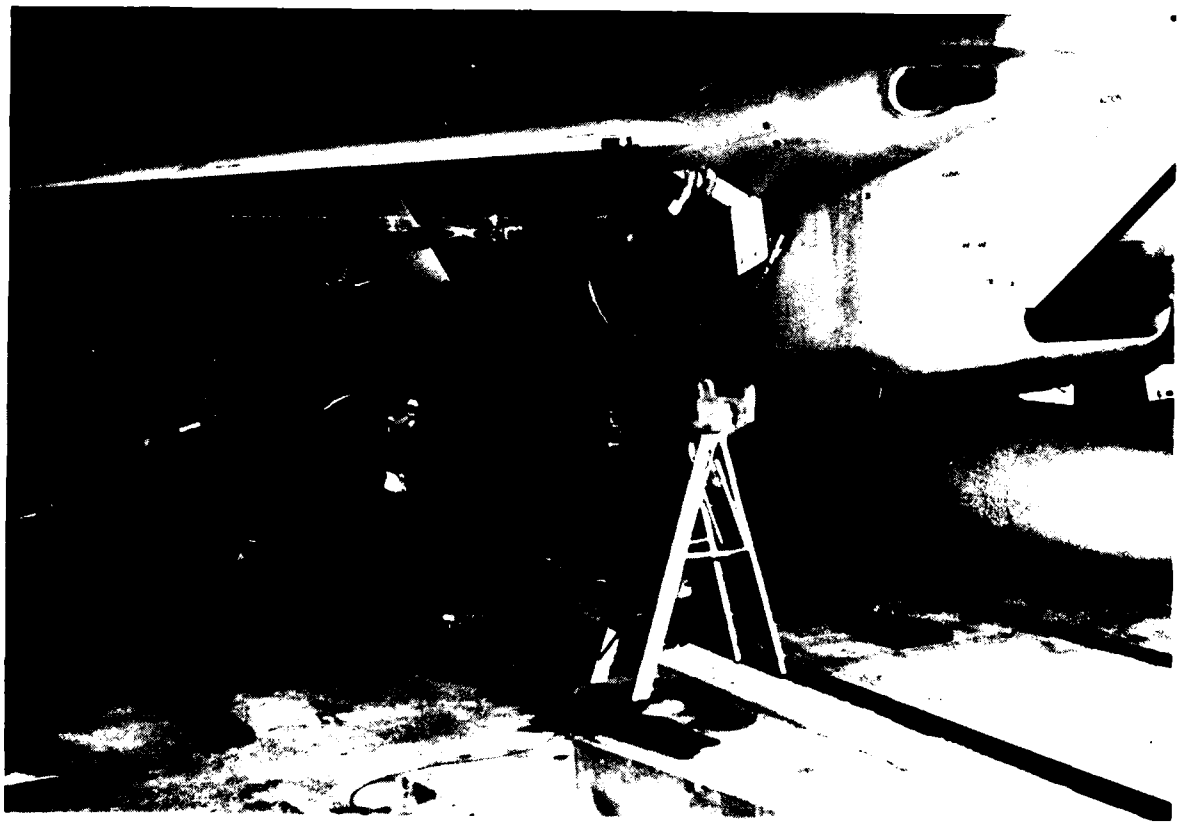
AIR COMBAT TACTICS & TRAINING RDT & E

WEAPON SYSTEMS LOGISTICS, MAINTENANCE, & TECHNICAL TRAINING RDT & E

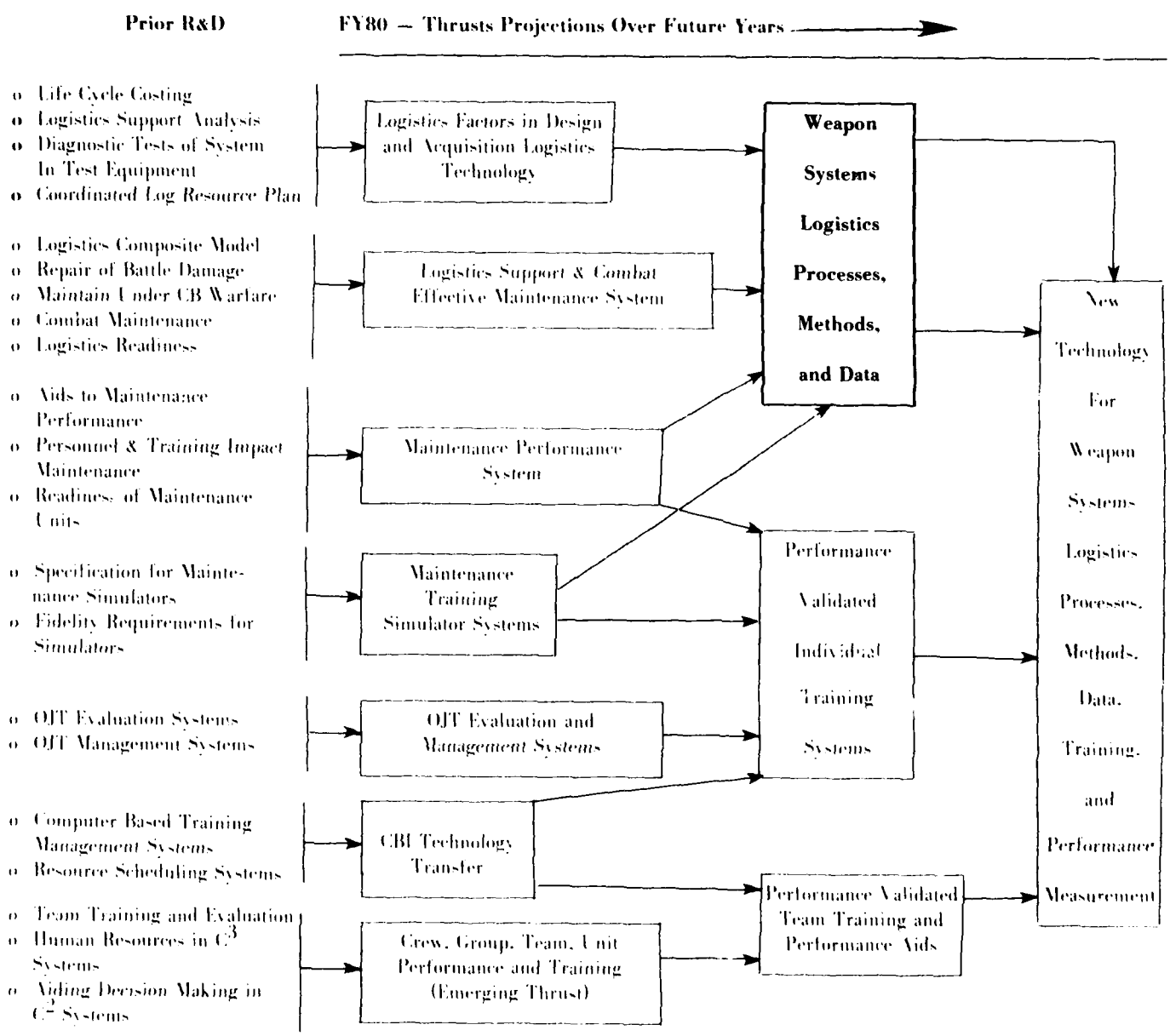
THE TECHNOLOGY BASE

TRAINING & PERSONNEL SYSTEMS TECHNOLOGY

WEAPON SYSTEMS LOGISTICS, MAINTENANCE, AND TECHNICAL TRAINING



WEAPON SYSTEMS LOGISTICS



Title: Comparison of LCOM, R&M, and EVM Models

Description: Three support-resource forecasting models were compared to identify similarities and differences in their capabilities. Among the factors examined were their inputs, methods of processing, outputs, and immediate utility in providing useful information to life cycle costing activities. The three models compared were the logistics composite model (LCOM), the reliability and maintainability (R&M) model, and the expected value model (EVM). LCOM is a Monte-Carlo simulation model, while both the R&M model and the EVM are average value, point estimate models. The purpose of the comparison was to clearly define the merits and limitations of each for use in supporting weapon systems development. Results indicated some degree of overlap in individual capability but, not clear-cut obviating by any model (in its present form) of the utility for specific purposes of either of the others. Further development and refinement of the models could reverse this conclusion. It was found that the R&M model and the EVM are similar, but not identical, in terms of inputs, processing, and outputs. The EVM makes better use of existing input data, while the R&M model provides outputs better suited to aid weapon system planners. The R&M model has been incorporated in a life cycle cost model: the Reliability, Maintainability, and Cost Model (RMCM). However, the EVM, with further development, could also be associated directly with a cost model. It was also found that meaningful comparison between the two expected value models and the LCOM was difficult because of their extremely different natures. The LCOM is dynamic and processes types of data which are not handled by either the R&M model or the EVM.

Utilization: One impact has been a decision to initiate a new effort to combine the R&M model and the EVM into a single average value model that will incorporate the best features of each and couple them with the costing capability of the RMCM. A second impact has been the recognition by the LCOM user community of the potential value and unique capabilities offered by the "average value" approach to resource forecasting, along with an increased understanding and appreciation of how the R&M model and the EVM relate to the LCOM simulation model.

Benefits: Results of this effort will come to fruition in the follow-up effort, in which a composite average value model will be developed from the R&M model, the EVM, and the RMCM. The new model will provide an economical capability to supplement use of the LCOM for resource requirements forecasting in situations wherein data availability, time and facility restrictions, and accuracy requirements call for alternative measures. This situation would be typical of the early phases of weapon system development.

AFHRL Contact: Sharon Nichols
AFHRL/LRLF
Wright-Patterson AFB OH 45433
Autovon 785-5910
Commercial (513) 255-5910

AFHRL Task Scientist Compares Various Resource Forecasting Models

Title: Development of Maintenance Demand Metrics-Phases I and II

Description: Mathematical regression equations were developed to relate equipment design characteristics, operations activities, and environmental conditions to maintenance demand rates for each subsystem of an aircraft. The regression equations are applicable to aircraft in general. The equations are intended to supplement, or replace, the traditional flying hours or sortie rates as predictors of maintenance demands. Based upon the equations, new maintenance demand metrics were developed for use in the Logistics Composite Model to determine requirements for maintenance manpower and other support resources. New work is being undertaken to develop production equations which are specific to classes of aircraft (e.g., tactical, bomber, trainer), and to investigate the logical basis of the statistical relationships.

Utilization: The products of this study provide more accurate means of predicting the maintenance demand rates of aircraft subsystems than the commonly used flying hours/sortie rates indicators. The more accurate predictions of maintenance demand rates used in conjunction with the newly developing support resource forecasting models, will allow for more accurate estimations of the requirements for maintenance manpower, spares and support equipment.

Benefits: The products of this study will provide more accurate estimations of the demand for maintenance than the traditional flying hours/sorties predictors. The products also provide insight into the determiners of equipment failure (design characteristics, environmental factors, operations requirements), thus allowing for corrective actions to be taken where maintenance demands are unusually high or otherwise unacceptable.

AFHRL Contact: Frank Maher
AFHRL/LRLA
Wright-Patterson AFB OH 45433
Autovon 785-5910
Commercial (513) 255-5910

Title: Models of Maintenance Resources Interaction

Description: Computer-based simulation models and mathematical regression equations were developed to describe the interactions among maintenance manpower, spare parts, and support equipment. The models and equations can be used to forecast the impact of various mixes of manpower, spares, and support equipment on aircraft readiness to fly both peacetime and wartime missions. The F-15 weapon system provided the resources and operational data for development of the models and equations. The Logistics Composite Model was used as the basis for the simulation models.

Utilization: The products of this study (i.e., computer simulation models and regression equations) can be used to forecast the impact of various mixes of maintenance manpower spares and support equipment on the readiness of aircraft to fly missions. The models and equations can also be used to determine the requirements for manpower spares and support equipment to provide desired/required levels of aircraft readiness.

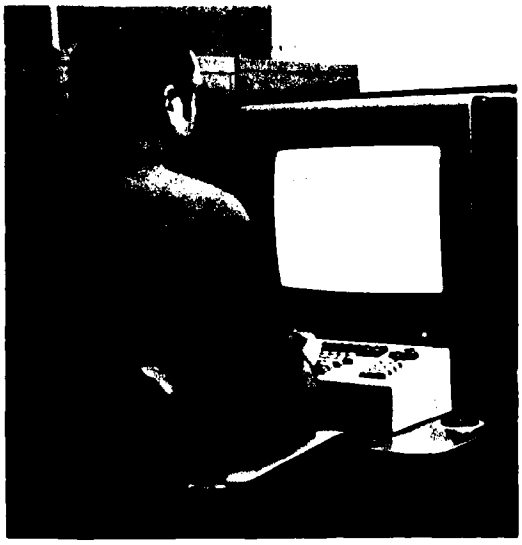
Benefits: The models and equations have two main benefits. They provide a means to determine resource requirements for desired levels of readiness. They also provide the means to perform trade-offs among various mixes of manpower, spares, and support equipment in terms of effects on dollar costs and on the ability of a system to meet peacetime readiness and wartime employment objectives.

AFHRL Contact: Frank Maher
AFHRL/LRLA
Wright-Patterson AFB OH 45433
Autovon 785-5910
Commercial (513) 255-5910

Title: Optimization of Format and Display Options for a Computer-Based Maintenance Aids System

Description: This research determined the type and format of information required by technical users of a computer-based technical order system. Of prime concern were the human factors elements of utilizing the power of a computer to optimize the information required to perform technical tasks. It was determined that a computer will permit the user to select the specific amount and type of data required for a given task. Three levels of detail were specified and appropriate formats were developed to present data in an outline format for fully qualified technicians; in a more detailed format for technicians with less experience; and in a step-by-step format for the novice mechanic. In addition, "pools" of specific information will be available for a quick brush-up on theory, procedures, etc. All levels and pools will be augmented with illustrations that graphically support the text. A functional keyboard was designed to permit the user with minimum typing skill to interface with the system.

Utilization: The research is being applied in the development of a prototype computer-based maintenance aids system for maintenance technicians. The human



Technician Using Experimental Computer Based Maintenance Aids System

factors research will help ensure that the prototype system meets the needs of and is acceptable to the technician.

Benefits: This research will help ensure that maintenance technicians can use a computer-based technical order system. Such a system should result in better maintenance because each user can select as much or as little information as needed for a given task.

AFHRL Contact: Donald L. Thomas
AFHRL/LRLM
Wright-Patterson AFB OH 45433
Autovon 785-3771
Commercial (513) 255-3771

Title: Transition of Improved Air Force Maintenance Concepts to Air Force and Other Organizations

Description: The Logistics Research Branch has led the Air Force and the Department of Defense in research to improve the technical orders used by maintenance personnel. This transition program is the vehicle that has made much of this technology available to Air Force, other services, and to civilian industrial organizations for application. Research personnel have served as consultants to Systems Program Offices (SPOs), Major Commands, and Air Force and Tri-Service technical order groups. During FY 80, consulting work was done with the Air Force Logistics Command, the F-16 SPO, the Air Force Technical Order Council, and with the Interservice Group on the Exchange of Technical Manual Technology. Discussions with and briefings to various government contractors have helped to transition the technology outside the Government as well as inside. Specific work was done to gather information about the use of Functionally Oriented Maintenance Manuals by the Navy. This information will be used by the Logistics Command and the Strategic Air Command to guide future procurements of technical data. The improved technical orders influenced by this research are now in use on F-16, B-52, and C-141 aircraft, among others.

Utilization: The transition effort is moving new technology into application which has the potential to improve the quality of maintenance accomplished on many first-line weapon systems. The new, improved technical orders can help first-term mechanics perform a wider range of tasks than their technical training prepared them for. The quality and quantity of tasks performed by newly assigned personnel would improve significantly the overall utilization of maintenance personnel, and also the quality of all maintenance accomplished.

Benefits: More and better maintenance can be accomplished if the new style technical orders are utilized properly.

AFHRL Contact: Robert C. Johnson
AFHRL/LRLM
Wright-Patterson AFB OH 45433
Autovon 785-3771
Commercial (513) 255-3771

Technician Using Job Guide Manual To Maintain B-52 Landing Gear

Title: Unified Data Base Technology

Description: The objective of this effort is a technology for a central automated source of logistics data drawn from basic Air Force systems to support the weapon system design process. Logistics data are those that would assist in obtaining answers to questions about logistics requirements as a function of alternative design/support concepts. Logistics data relate directly or indirectly to reliability, maintainability, ground support equipment, built-in test equipment, task analysis, skill level, skills, crew size, training requirements, technical data, and spares. The basic data systems for this technology are the Logistics Support Analysis Records (MIL-STD 1388), Maintenance Data Collection System (AFR 66-1), and Logistics Composite Model Technology (AFR 25-5). The feasibility of this technology will first be established. This will entail developing an initial definition and a *concept of operation*. The technology will then be developed, and later tested and evaluated.

Utilization: This technology and the resulting enhanced availability of logistics information will allow for a significantly increased consideration of logistics factors throughout the weapon system design process. A significant decrease in logistics costs for modern weapon systems should result. This effort is in support of a larger effort underway to develop a Product Performance Feedback System. The Unified Data Base is concerned with a limited prototype which addresses aircraft only. The Product Performance Feedback System is to address missiles and ground-based electronics also, building upon the Unified Data Base technology. The Product Performance Feedback effort is also concerned with implementing the technology, and interfacing the technology development effort with its future potential users.

AFHRL Contact: Robert N. Deem
AFHRL/LRLA
Wright-Patterson AFB OH 45433
Autovon 785-3771
Commercial (513) 255-3771

Title: Cause-Effect Cost Analysis

Description: This effort is to define and document an approach to the analysis of ownership costs which is operable in the conceptual stage of weapon system development and is based on cause-effect impacts. It will demonstrate the feasibility of identifying and quantifying cause-effect functional relationships between system design/operation parameters and the system support requirements they generate; which, in turn, drive ownership cost. Three types of systems are being examined: aircraft avionics, missile avionics, and aircraft propulsion systems. A computerized methodology is being developed for using the cause-effect relationships to provide quick response cost estimates which reflect the specific logistics support consequences of *particular* system design and operation alternatives.

Utilization: Products of this effort will increase the accuracy of estimates of cost and support resource requirements during the conceptual phase of system development. The cause-effect approach will provide greater insight into the process of design/operation/support requirement *interaction* and allow for very early evaluations to be made of design/support alternatives in terms of their specific impact on ownership cost. The capability will permit early system development actions to avoid support cost by allowing a step-by-step tracing of specific consequences of system ownership to the parameters of design and operation which cause them.

AFHRL Contact: H. Anthony Baran
AFHRL/LRLA
Wright-Patterson AFB OH 45433
Autovon 785-3771
Commercial (513) 255-3771

Title: Evaluation of Technology for Acquiring Supportable Systems

Description: This is the final phase of a four-part effort to develop and field a coordinated technology for the human resources and logistics support of weapon system development. The coordinated technology consists of an integrated assembly of models, techniques, a consolidated data base, and a methodology useful for their combined and timely application throughout the weapon systems acquisition process. Its purpose is to greatly facilitate and systematize the evaluation of resource requirements and cost throughout weapon system development, and to increase the feasibility of implementing those considerations as guidelines for design and system support planning. The ongoing effort is to evaluate and complete the integration of the coordinated technology and to complete its preparation for operational use. Products of the effort will include results of the evaluation; documentation and application guidance specifically tailored for three levels of project

management; and training materials for field personnel, which are similarly tailored to aid implementation by managerial and technical personnel.

Utilization: Use of the coordinated technology in weapon system development programs will significantly increase Air Force capability to consider design, operation, and life cycle ownership consequences more fully as joint trade-offs. It will also allow the evaluation of system support trade-offs, such as technical data versus training, to occur earlier and influence the selection of design and system support alternatives. The overall impact is life cycle cost avoidance through a more effective application of analytical techniques and a more coordinated sequencing of design development activities which relate to logistics support planning. Furthermore, individual components of the coordinated technology, such as the Personnel Availability Model or the Training Requirements Analysis Model can benefit users in personnel management and training requirements forecasting activities.

AFHRL Contact: H. Anthony Baran
AFHRL/LRLA
Wright-Patterson AFB OH 45433
Autovon 785-3771
Commercial (513) 255-3771

Title: Maintenance Demand Metrics-Phase III

Description: This is a continuation of the work to develop better predictors of demand rate for aircraft maintenance. The earlier effort developed regression equations which predict maintenance demand rates for aircraft subsystems as a function of environment, design characteristics, and operations requirements. These equations are general to all types of aircraft. The new work will develop equations specific to types of aircraft, (i.e., tactical, bomber, and trainer), as well as specific to type of subsystem (e.g., bombing-navigation, landing gear, engines). The new work also will investigate the logical basis of the regression equations.

Utilization: The new regression equations that are specific to type of aircraft as well as specific to type of subsystem will provide much more precise and accurate predictors of maintenance demand rates. This in turn will lead to more precise estimations of the support resource requirements. To the extent that logical bases can be established for individual regression equations, corrective or preventive actions could be taken to reduce the demand for equipment maintenance. For example, if equipment characteristics contained within a regression equation are logically related to the subsystem, then it would seem sensible that changes in those characteristics would affect the maintenance demand rates. However, experimental testing would be required to confirm such logical relationships.

AFHRL Contact: Frank Maher
AFHRL/LRLA
Wright-Patterson AFB OH 45433
Autovon 785-5910
Commercial (513) 255-5910

Title: MACRO Model of the Air Force Logistics System

Description: The MACRO Model is designed for use in policy development and in resource control. It is designed to enhance the understanding of the overall impact of the policies established by senior management upon the very complex logistics system. Simultaneously, it provides a means to evaluate the effects of these policies. The prototype model for this effort was developed by means of extensive interviews conducted throughout the logistics community. The results of these interviews allow the researchers to define and gain a comprehensive understanding of the logistics system, its organization, functions, and interactions among its various principal components. The prototype model has identified 27 processes in the logistics system. Flow diagrams are being designed for all 27 processes, and those diagrams, which are based upon the earlier interviews, will then be verified. An elaboration of the processes will indicate basic structure and the flow between the various functions. The MACRO Model of the logistics system will

provide information concerning the many interactions among logistics elements, processes, and functions. The Air Force Logistics System is a classic information feedback structure. The approach of the ongoing research is to decompose this structure into a series of steps based on system conceptualization, analysis, and measurements.

Utilization: The MACRO Model developed through this research will be the basis of policy development and resource control by senior Air Force managers within the logistics community. The MACRO Model will also be used as a tool for teaching the logistics system and its interactions at the Air Force Institute of Technology resulting in an improved understanding of the complexities of the Air Force Logistics System.

AFHRL Contact: James McManus
AFHRL/LRLF
Wright-Patterson AFB OH 45433
Autovon 785-5910
Commercial (513) 255-5910

Maintenance Supervisor Being Interviewed In Study of Factors Which Impact Maintenance

Title: Identification and Analysis of Factors Influencing the Performance of Air Force Maintenance

Description: Effective and efficient maintenance of Air Force systems and equipment is an extremely important factor in determining the reliability, effectiveness, cost, and operational safety of weapon systems. The safety of aircrew personnel obviously depends on effective maintenance.

This research is designed to develop a comprehensive, integrated long-range program that will identify the factors that impact the performance of individuals, groups, and organizations who perform aircraft and missile maintenance. The program will identify the human-related research areas that are most likely to result in the improvement of the performance of maintenance personnel.

The approach of the study is to examine the problem from the top to the bottom. This is being done by conducting open-ended one-on-one interviews with all levels of maintenance personnel. The scope of the interviews will range from senior personnel through the working level technician. All the Major Commands, including the Air Forces in Europe, the Pacific Air Forces, and the Reserve Forces, will be represented. In selecting data collection sites, consideration is given to such things as geographical location, climatic conditions, weapon system, and mission rate. Improvements in both wartime and peacetime maintenance performance are the desired results of this project.

The research is an application of an integrated approach to maintenance research, with special attention to the role of the human in effective and efficient maintenance. It will provide the basis for an integrated research and development program that will identify and quantify the factors that influence maintenance performance.

Utilization: This research will yield a more valid picture of the maintenance system and identify key research issues. The analysis of the data collected will identify opportunities for application of existing technology to improve maintenance. Problems that require research will be identified and the means for studying them will be proposed. The research plan resulting from this effort will identify future maintenance and logistics research and development needs. The application of existing technologies and the technological advances developed through research programs conducted as a result of this study will significantly improve Air Force maintenance operations.

AFHRL Contact: Richard E. Weimer
AFHRL/LRLM
Wright-Patterson AFB OH 45433
Autovon 785-3771
Commercial (513) 255-3771

Title: Development and Evaluation of a Prototype Computer Based Maintenance Aids System

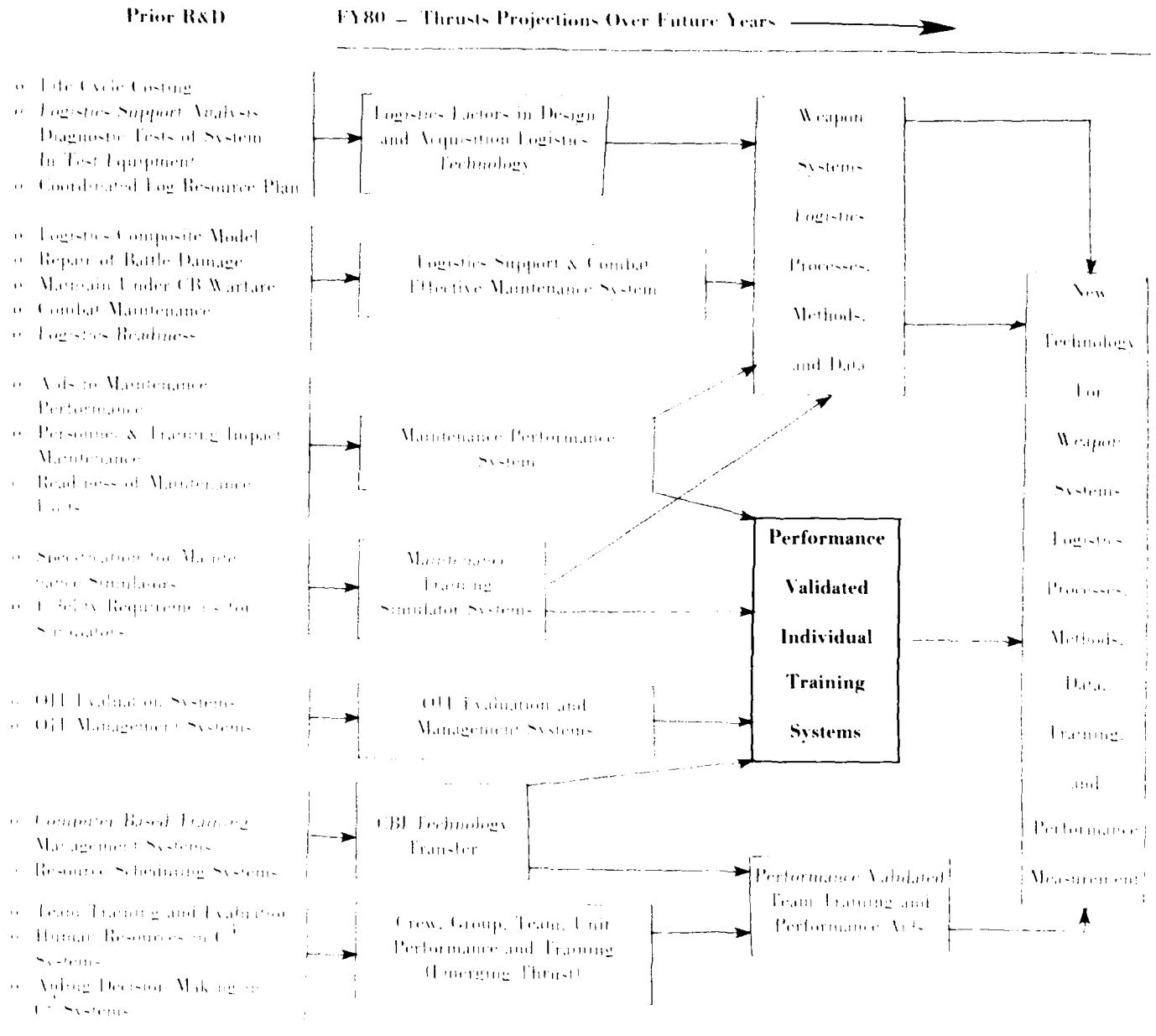
Description: The purpose of this project is to develop and evaluate a prototype computer-based maintenance aids system. The system will store, retrieve, and present information for use by technicians for performing maintenance tasks at the intermediate level. The goal is to develop a system which is easy to use, liked by technicians, and provides the technician with all of the information needed for the task. Human factors requirements are being emphasized in the system design. The system will present instructions at three levels of detail. This feature will provide the technician with instructions which are appropriate for his level of experience (very detailed step-by-step procedures with illustrations for inexperienced technicians, less detailed instructions for more experienced technicians). A computer graphics terminal will be used to present the technical data. The presentation of data on the prototype system will be controlled by the host computer and a modified version of the software for the Advanced Instructional System. Technical data for two test bed systems (an avionics subsystem and a mechanical subsystem) will be developed and placed on the prototype system. These data will be used to evaluate the system. The system will be evaluated by measuring the effectiveness of technicians using the prototype system to perform maintenance on the test bed systems.

Utilization: The technology developed in this project will provide the basis for development of an effective technical data presentation system for the Air Force Logistics Command Automated Technical Order System. The technology will insure that the ATOS data presentation system is easy to use and meets the needs of the maintenance technician for technical data. The operational use of a computer-based maintenance aids system will significantly reduce the costs of maintaining the Air Force technical order system by reducing printing costs and reducing the cost of updating technical orders.

AFHRL Contact: Donald L. Thomas
AFHRL/LRLM
Wright-Patterson AFB OH 45433
Autovon 785-3771
Commercial (513) 255-3771

Technician Using A Computer-Based Maintenance Aids System To Perform Intermediate Level Maintenance

TECHNICAL AND MAINTENANCE TRAINING



Title: Development of On-the-Job Training Capacity Model

Description: As budgetary considerations force program restrictions in the Air Training Command, much of the training previously conducted in resident courses is moved into the On-the-Job Training (OJT) setting. When field supervisors become responsible for additional training over and above their operational mission, the danger exists that quality of training, mission performance, unit readiness, or all of these, may suffer. The Air Force lacks a quantifiable model for determining the relationships between these outcome variables and the amount of OJT conducted in various units. Optimum training load in OJT was studied in this context. Attempts were made to specify, in objectively measurable terms, the factors which impact a unit's capacity to conduct OJT without mission requirements being impaired. Training load was conceptualized as the residual when resources devoted to mission accomplishment are subtracted from total resources (i.e., manpower, equipment, etc.) available to a unit. It is hoped that more precise and measurable definitions of these factors can be formulated in subsequent work.

Utilization: When the capacity model is developed, demonstrated, and validated, Air Staff and Air Training Command managers will be able to make more objectively verifiable, data-based decisions with regard to whether a course of instruction should be taught in residence or in the OJT program. The present model is described in AFHRL-TR-80-46, *Capacity of Air Force Operational Units to Conduct on the Job Training: Development of Estimation Methodology*.

Benefits: Results of this preliminary work on OJT capacity analysis will enable better definition of OJT cost and capacity evaluation requirements for subsequent development and demonstration of a new integrated OJT management system. Also, results have potential application to development of prototype training decision models addressing resource trade-offs and constraints associated with assigning tasks to be trained to formal courses or OJT.

AFHRL Contact: Roger Pennell
AFHRL/LRTT
Lowry AFB CO 80230
Autovon 926-4388
Commercial (303) 370-4388

Title: Writer's Aid Computer Program

Description: This effort produced a FORTRAN program which accepts, as input, text typed into a computer and outputs a variety of information useful to writers and others concerned with the readability of Air Force documents. The program is designed specifically for Air Force texts and provides four readability estimates, three of which were validated on military material, as well as text parameters (e.g., mean words per sentence). The program will additionally print out "problem aspects" (e.g., over long sentences) of a given text and will automatically generate CLOZE comprehension tests so that formula estimates can be supplemented with the actual comprehension scores of personnel.

Utilization: This program will enable the automated evaluation of the texts of Air Force writers who are complying with Air Force Regulation 5-1, Air Force Publications Management Program, and will allow writers to train themselves to create more readable and comprehensible texts. It is seen as particularly useful to writers of regulations and to developers of training curricula.

Benefits: Use of this automated readability evaluation program will allow more systematic and less labor intensive assessment of whether Air Force documents are written to appropriate target audience difficulty levels.

AFHRL Contact: Lt William R. Green
AFHRL/LRTA
Lowry AFB CO 80230
Autovon 926-2775
Commercial (303) 370-2775

Title: Development and Validation of the Learning Strategies and Skills Training Program

Description: Research has documented that most students tend to employ less-than-effective and/or inefficient methods for acquiring, retaining, and applying information. It has become evident that methods designed to organize information for presentation to learners are of limited effectiveness for their acquisition, retention and application of knowledge. In contrast, strategies which the learner finds useful in transforming information through personal effort are likely to be owned, and retained. These contribute to increased

performance. Programmatic research was initiated (a) to identify and compare the effectiveness of alternative learning strategies upon learned performance, (b) to incorporate effective strategies and interactive practice materials within a systematic training program, and (c) to empirically validate the performance of strategies-trained and untrained students. Some of the strategies included have been (a) various mnemonic devices, (b) imagery elaboration, (c) paraphrasing, (d) visual networking, (e), goal-setting, (f) distraction desensitization, and (g) peer interaction.

Utilization: Strategies-trained students achieve 17% to 30% more than untrained students on technical subject matter achievement tests. Low reading-aptitude students achieved more given imagery strategies training than did low reading controls under the paraphrasing or the untrained strategies condition. Visual networking strategies students scored 26% higher on delayed retention achievement tests than did controls in the untrained group. In most cases, high reading aptitude students achieved more than lower reading aptitude students.

Benefits: Arming learners with generalizable strategies and skills for coping with large amounts of technical information would appear to be a more rational and efficient approach than teaching unstable specific subject matter content. The latter approach produces a person whose job effectiveness is largely dependent on specific content. In contrast, individuals who have mastered learning strategy skills, become relatively independent learners who are in a better position to cope effectively and efficiently with job-technology change. Indeed, such individuals are likely to be the authors of change. The Air Training Command is currently implementing a learning skills program prior to course entry to increase subsequent student performance.

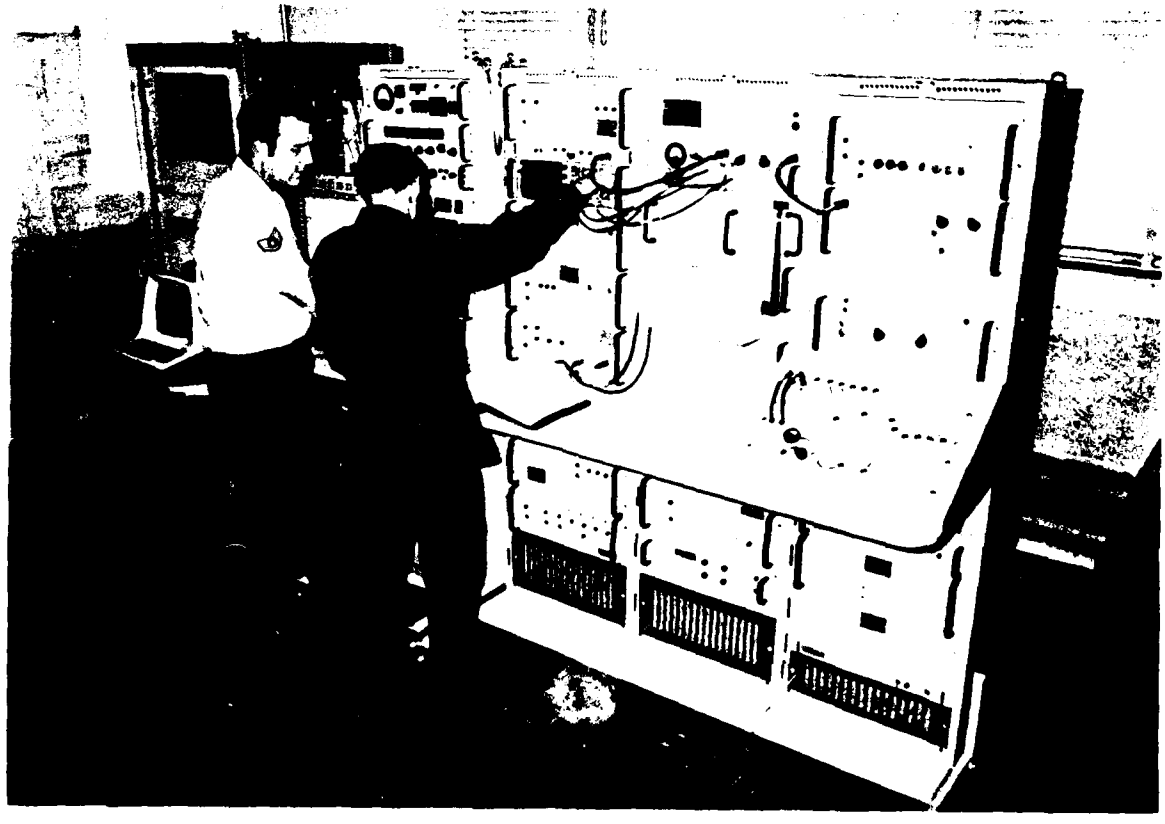
AFHRL Contact: Gerard M. Deignan
AFHRL/LRT
Lowry AFB CO 80230
Autovon 926-3391
Commercial (303) 370-3391

Title: Design and Delivery of Flat-Panel 6883 Simulator for Comparison with Three-Dimensional Maintenance Simulator

Description: The objective is to develop a flat-panel simulation of the 6883 Converter/Flight Controls Test Station associated with intermediate level maintenance of the F-111 aircraft. The simulator will subsequently be used in studies of the impact of psychological fidelity inherent in real equipment, three-dimensional simulators, flat-panel simulators, and graphics simulations on technical training and subsequent job performance. The civilian contractor will design a flat-panel simulator providing comparable training capability to the three-dimensional simulator previously developed. To maximize comparisons between the two simulators, parameters will be contrasted insofar as practical. Initial areas where contrasts appear to be feasible are (a) physical fidelity, (b) minicomputer versus microprocessor control, (c) FORTRAN programming versus an ATLAS-like language, (d) degree of integration with theory portions of course, (e) environmental requirements, (f) indigenous versus adjunctive knowledge of results, (g) relative emphasis on procedures and system logic, (h) degree of performance monitoring, and (i) efficacy of stand-alone part-task trainers associated with the simulator.

Utilization: This research will result in a flat-panel simulator and the associated documentation required for update and modification of the simulator. The simulator will be utilized in developing future trainer requirements and specifications, developing training programs for new weapon systems, such as the MX missile, and also for improving training on existing systems. One area of particular interest is the impact of lowered fidelity on the time required to develop and implement new training programs. Another area of interest is the impact of varying maintenance concepts on life-cycle costs.

AFHRL Contact: Edgar A. Smith
AFHRL/LRTI
Lowry AFB CO 80230
Autovon 926-1386
Commercial (303) 370-1386



Burtek Flat Panel Simulation Of F-111D 6883 Flight Converter Test Station

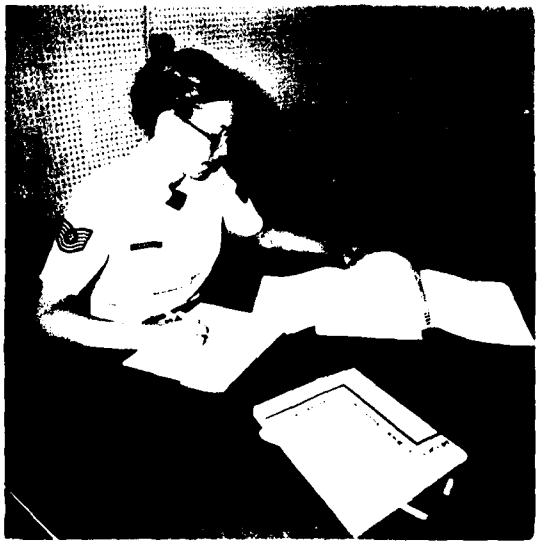
Title: Handbooks and Model Specifications for the Design and Development of Maintenance Simulators

Description: The objective of this study is to collect, analyze, and document data in order to develop a set of introductory handbooks for Instructional System Development (ISD) teams and Training System Acquisition managers involved in requirements development, design, and procurement of maintenance simulators. In addition, this effort requires the development of model functional specifications for the design of both organizational and intermediate level maintenance training simulators for utilization, in resident school and field training environments. The six-step approach that will be used involves the collection, analysis, and documentation of information on the design, fabrication, and life-cycle maintenance of maintenance simulators. This research is being conducted by a contractor through a process of information requirements analysis to include (a) development of techniques and decision aids based upon an analysis of maintenance task classifications and (b) development of guidelines/handbooks, and model specifications which incorporate the preceding data collection and analysis. The ISD handbook provides procedures for (a) determining the most effective mix of training equipment (trainers primarily used by students to practice required task/part-task activities) for all types of maintenance training requirements, (b) prescribing the most appropriate design features and trainers, and (c) documenting maintenance simulator design so that it can be efficiently translated by a Systems Program Office (SPO) Training Device Acquisition Manager into a procurement specification with the aid of the SPO handbook.

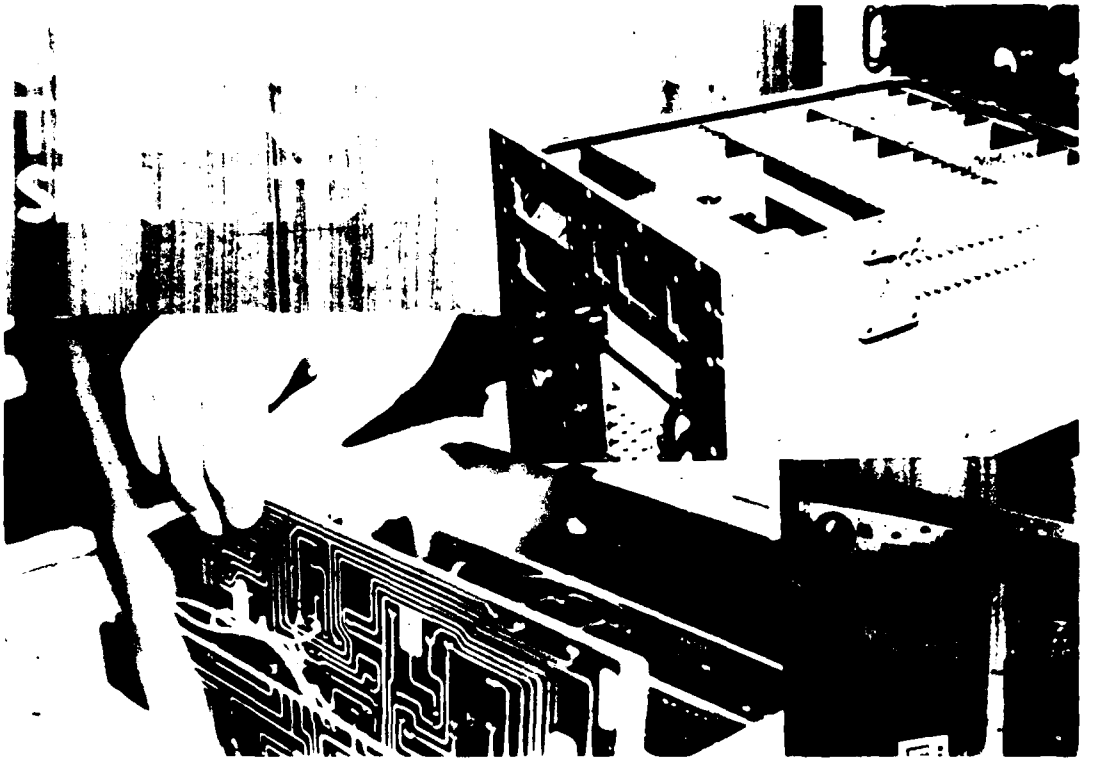
These procedures will be implemented on electronic word and data processing equipment to explore the feasibility of the technique and to assess the impact on the time required in conducting ISD. A separate model specification/handbook will be developed for SPO personnel providing a fill-in-the-blank model specification and a handbook providing background and information relevant to the specific requirement. These entries will be number coordinated with the ISD model specification to assure that training requirements are fulfilled. This will also provide a basis for acceptance testing to verify that the device does in fact provide the required instruction.

Utilization: It is anticipated that the resultant documents will be useful to ISD teams during the development of training specifications for maintenance simulators and to the SPO activities in the translation of these training requirements into equipment specifications in such a way that efficient and effective training devices will result.

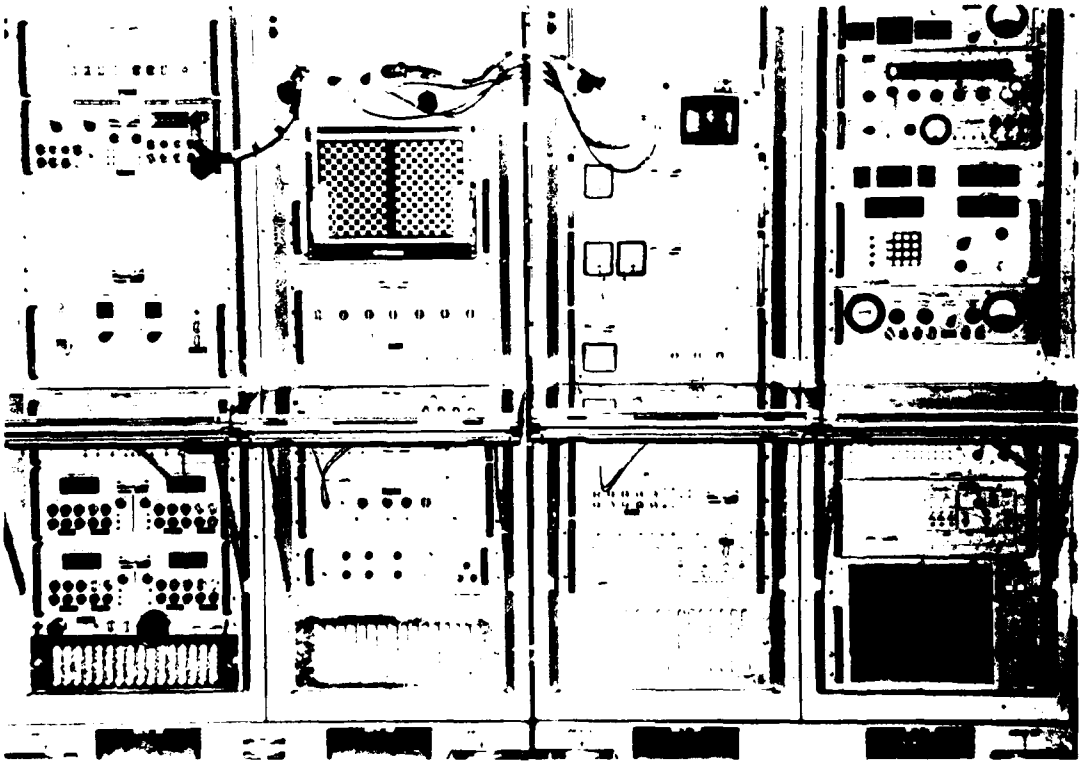
AFHRL Contact: Edgar A. Smith
AFHRL/LRTT
Lowry AFB, CO
Autovon 926-4386
Commercial (303) 370-4386



Training Technologist Using Maintenance Simulation Design Handbook



Pullout Drawer On Honeywell 3-D Simulator



Front View Of Actual 6883 Equipment

Title: Comparative Evaluation of High and Low Fidelity 6883 Maintenance Simulators with Actual Equipment

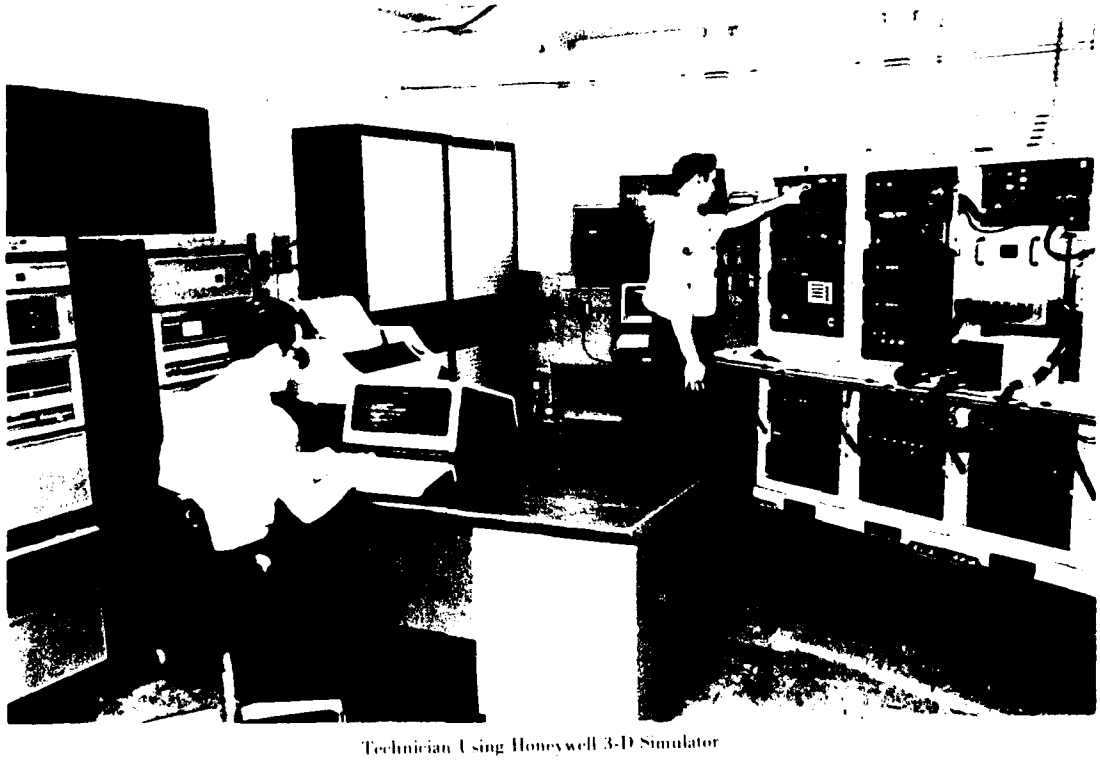
Description: The following questions are to be considered: (a) Do simulators train students as effectively and efficiently as do actual hardware? and (b) How effectively do simulator and actual hardware trained students transfer skills to the real world of troubleshooting problems?

To provide competent maintenance technicians to the field, expensive actual equipment is customarily employed for training. As a training device, actual equipment does not readily permit the controlled presentation of malfunctions representative of troubleshooting problems occurring frequently in operational settings. Less expensive real-time simulators do possess the capability for troubleshooting training, which incorporates hands-on practice to increase troubleshooting skill on a sample of field-related maintenance problems. In addition to improved skills training, properly designed computer-based training simulators also have the potential to release more expensive actual equipment for operational readiness. To this end, objective data are required to determine the conditions and alternative simulation designs which result in job competent personnel for the least cost.

Major objectives of this evaluation are to compare two maintenance training simulators (three-dimensional and two-dimensional) and actual maintenance equipment on dimensions of instructional effectiveness, cost-benefit, and attitudinal acceptance within an operational Air Training Command course.

Utilization: Students trained on the 6883 3-D simulator performed as well as students trained on actual equipment, despite less than optimal evaluation conditions. Specifically, no significant differences in troubleshooting effectiveness or field performance were found as a function of training or testing modes. Since the 6883 test station was one of the more reliable stations, cost savings might be significantly higher if simulators could replace two or more of the ten different actual equipment test stations currently in use. Comparison of the low fidelity (2-D) simulator with the higher fidelity (3-D) simulator and actual equipment is currently underway. Though simulators have been employed as training devices for years, methodologically sound comparative studies of simulator versus actual equipment training effectiveness and life cycle costs are conspicuously rare. Readiness to perform depends largely on sufficient numbers of skilled task performers. To assure such readiness, empirical data are required to answer the following question: For which tasks and for which trainees is simulation more effective and/or efficient than actual equipment?

AFHRL Contact: Gerard M. Deignan
AFHRL/LRTT
Lowry AFB CO 80230
Autovon 926-3391
Commercial (303) 370-3391



Technician Using Honeywell 3-D Simulator

Title: Development of a Flight Simulator *Troubleshooting Trainer*

Description: Because of increasing aircrew training demands upon flight simulator availability, blue-suit maintenance personnel both in the Continental United States and overseas have a smaller opportunity to use flight simulators for maintenance training. To fill this ever-widening gap between maintenance training requirements and training capabilities, a prototype troubleshooting trainer is being developed. To be built to take advantage of state-of-the-art concepts in training equipment design and microprocessor technology, this trainer will provide technicians a substantially improved capability for the hands-on practice of troubleshooting many of the more frequently occurring malfunctions in the flight simulator. The technical approach adopted for development of this trainer consists of modeling the major subsystem components of a representative flight simulator, with emphasis on the functional and logic flow relationships of the components, and then constructing a wide range of simulated malfunctions for the technician to practice diagnosing and correcting. To further enhance the overall effectiveness of the trainer, additional instruction features, such as automated performance measurement and automated student feedback, are to be incorporated within the device.

Utilization: The first application of the trainer is to be for the F-111D flight simulator, a relatively complex and mature flight simulator. If the approach embodied in the troubleshooting trainer is validated in this initial application, similar trainers could be developed for the full range of present and future flight simulators. Furthermore, the results of this effort may eventually be generalized to other complex electronic systems that are similar to flight simulators in computer design or architecture where the opportunity for maintenance training is restricted.

AFHRL Contact: Capt Philip A. Irish, III
AFHRL/LRTT
Lowry AFB CO 80230
Autovon 926-4386
Commercial (303) 370-4386

Title: Specification of a Trainer for Ultrasonic Nondestructive Inspection

Description: Ultrasonic nondestructive inspection technology is used widely for the investigation of the structural integrity of airframes, aircraft engines, and aircraft hardware components within both military and commercial aviation. Recent wide-scale performance

Technician Performing Nondestructive Inspection On A-7D Wing Fold Rib Pylon Lugs

testing using nondestructive inspection has resulted in the formulation of serious allegations challenging the previously accepted ability of Air Force technicians in the field to find flaws in aircraft structures with the precision and reliability demanded by aircraft design engineers. As a result, the Air Force has identified the improvement of the opportunities for field practice of ultrasonic inspections as being an urgent training requirement. Thus, the prime objective of this effort is to develop a detailed specification of a prototype trainer to be used to develop, measure, and sustain the operational proficiency of Air Force personnel to use ultrasonic nondestructive inspection systems. A secondary objective is to gather systematic information about the utility of two previously developed preliminary handbooks for the design of training equipment for maintenance personnel. The specification of the trainer will be accomplished through the implementation of the preliminary handbooks in two phases. In the first phase, the performance capabilities of the trainer will be defined, along with the behaviors to be sustained by the trainer. In the second phase, procedures outlined in the handbooks will be followed to determine the engineering/physical characteristics which the trainer must have in order to provide the desired functional characteristics.

Utilization: The result of this effort will be a complete and detailed set of specifications for an ultrasonic inspection trainer which may be used by an equipment acquisition agency to acquire a prototype article. It is anticipated that acquisition of such a trainer will improve

the reliability of ultrasonic nondestructive inspections within aircraft maintenance programs ultimately resulting in safer, less costly USAF ground and flight operations.

AFHRL Contact: Capt Philip A. Irish, III
AFHRL/LRTI
Lowry AFB CO 80230
Autovon 926-4386
Commercial (303) 370-4386

Title: Interactive Computer Graphics Simulation for Intermediate Level Maintenance Trainer

Description: The potential for interactive computer graphics to provide part-task simulation capability for maintenance training is very high. The objective of this effort is (a) to demonstrate the feasibility of using interactive graphics simulation as a cost-effective adjunct in a learning center consisting of an F-111 6883 Converter/Flight Controls Test Station and a three-dimensional simulation, (b) to investigate the training effectiveness of graphics simulation, (c) to develop a functional specification for a low-cost stand-alone interactive graphics learning environment, (d) to explore such issues as color, fidelity, and resolution requirements, as well as embedded instructional strategies. The test bed will be built on the existing R&D capabilities of the computer-based instructional system at Lowry AFB. These capabilities include data collection and analysis, computer-assisted instruction, and computer graphics generation.

Utilization: This research will produce a graphics simulation for 6883 test station tasks, specifications for a low-cost device targeted for the training environment and a research test bed for the resolution of issues associated with maintenance training graphics simulations. Furthermore, the test bed can be considered as a prototype system for establishing functional specifications for a variety of part-task training simulations. Such a system could be used by the Systems Program Office in determining least-cost simulations. Graphics simulations have been successfully employed in many equipment operator and maintenance training situations. This effort is extremely important in determining the correct match for a training task and its graphics level simulation. The results of this effort will be used to develop graphics level simulations for new weapons systems and equipment as well as for current systems.

AFHRL Contact: Brian Dallman
AFHRL/LRTI
Lowry AFB CO 80230
Autovon 926-3391
Commercial (303) 370-3391

Interactive Computer Graphics Simulation of F-111D 6883 Flight Converter Test Station

Title: Functional Literacy Task Inventory

Description: Although the Air Force has been much concerned with the problem of making sure that the literacy demands of a career field are not beyond the capacity of personnel assigned to that field, no study has been performed to determine precisely what these demands are for different jobs. Also, the consequences of a mismatch between job reading demands and personnel reading ability have also not been determined. The present effort represents the first step in the attempt to obtain answers to these questions. By means of successive cycles of tryout, data analysis, and survey instrument refinement, a methodology for the task analysis of job-related literacy tasks is being developed.

Utilization: The eventual product of this effort will be a field-tested survey instrument for use within the framework of the Air Force occupational survey system. The administration of this survey will allow the characterization and clustering of Air Force jobs in terms of their literacy task demands. This information should ultimately lead to more job-specific, job-relevant reading improvement training, more precise and cost-effective personnel assignment, and better design of Air Force documents.

AFHRL Contact: James R. Burkett
AFHRL/LRTT
Lowry AFB CO 80230
Autovon 926-4388
Commercial (303) 370-4388

Title: Evaluation of Standardized Position Oriented Training (SPOT) System

Description: In recognition of the need to devote more management attention to On-the-Job Training (OJT), the Air Force contracted for a large-scale systems analysis of the OJT program, which was completed in December 1975. One of the problem areas indicated by this analysis was that training tasks were not clearly defined. The most vital step in developing any training program is identification of task training requirements. Unless these requirements are precisely and clearly spelled out, it is nearly impossible to develop a viable program. The Specialty Training Standard, which is presently used to develop the OJT Job Proficiency Guide, in many cases is much too general to be used as a task list for OJT. It is satisfactory as a basic document for development of Career Development Courses, technical training courses, and Specialty Knowledge Tests; however, it lacks the specificity required for task training. HQ USAF is experimenting with a new position-oriented approach to OJT called SPOT (Standardized Position Oriented Training). In the prototype system, occupational survey data are used to select required tasks and identify job types. OJT can then be required for those tasks associated with the particular job type to which a trainee is assigned. The Air Force Human Resources Laboratory is developing new ways of organizing occupational survey data so that they can be used to design various characteristics of the SPOT system. The end product of this effort will be a set of strategies and related software for development of position-specific task listings. Work is underway to evaluate the strategies for extracting task listings from the occupational data base in terms of utility in the field for OJT.

Utilization: This effort will provide the Air Force with a method of developing clearly defined OJT training requirements for each job type within every Air Force Specialty Code. The OJT trainer will have a more definitive set of job-specific tasks with which to train and evaluate training results. The results should be a more efficient training system and a better system for tracking of training, especially for personnel after a permanent change of station.

AFHRL Contact: Stephen V. Offutt
AFHRL/LRTT
Lowry AFB, CO 80230
Autovon 926-4388
Commercial (303) 370-4388

Title: Task Proficiency Evaluation in Air Force On-the-Job Training

Description: The objectives of this research are to develop task level proficiency evaluation procedures specifically oriented to On-the-Job Training (OJT) requirements for both maintenance and nonmaintenance applications and to provide operational guidelines and training quality control techniques for new approaches to OJT evaluation. The OJT evaluation procedures developed in this effort will be described in a handbook for use by OJT administrators and supervisors in ensuring that task proficiency evaluations are being conducted properly.

Utilization: There is a recognized need for better operational procedures for determining whether individual trainees in OJT programs have attained necessary task proficiency. OJT task evaluation procedures are not currently as objective and standardized as they should be, particularly in nonmaintenance specialties. This effort will explore and try out new alternatives for OJT task proficiency evaluation designed to meet the needs of OJT trainers and managers in the field. Those new techniques that are found to be feasible will be outlined in handbooks for field implementation.

AFHRL Contact: Stephen V. Offutt
AFHRL/LRTT
Lowry AFB, CO 80230
Autovon 926-4388
Commercial (303) 370-4388

Title: Development of Specifications for an Integrated Training System for Air Force On-The-Job Training

Description: The objectives of this effort are to conduct a system definition study of Air Force On-the-Job Training (OJT) and to prepare a detailed functional specification for design and development of a new integrated OJT evaluation and management system. This research will (a) identify requirements and functions at all levels of the OJT program and propose alternative approaches to meeting the requirements and performing OJT system functions, (b) define a primary prototype system, along with alternative systems, to meet the needs of the Air Force OJT program, and (c) by means of trade-off analyses, produce a detailed system development specification for a new OJT system prototype. This

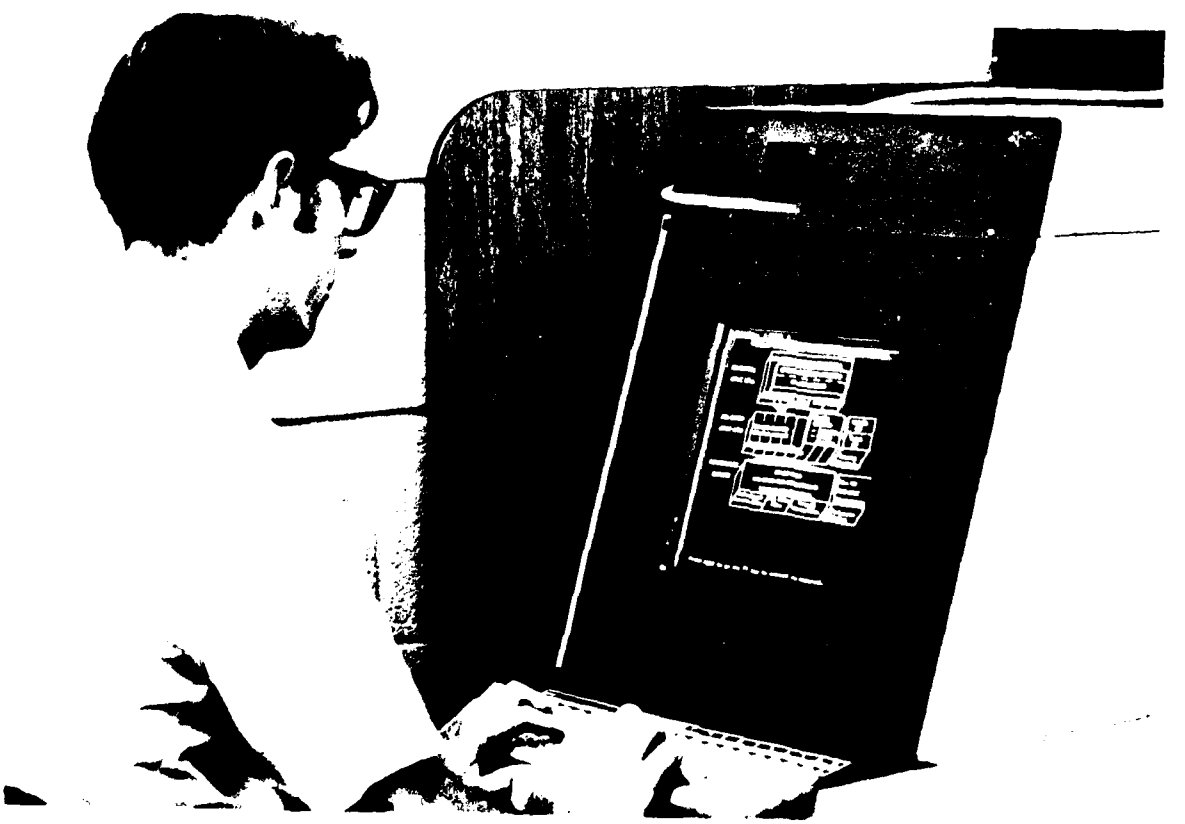
specification will subsequently be used to develop and demonstrate a computer-based integrated training system for the development, management, and quality control of OJT.

Utilization: The present effort will culminate in functional and design specifications for a new OJT system. The following benefits are anticipated from the implementation of such a system: (a) better techniques for systematic definition of task training requirements and improved task evaluation procedures for OJT, (b) use of state-of-the-art instructional technology in the OJT setting, (c) introduction of computer-supported scheduling of record-keeping, testing, and training management into OJT, and (d) development of OJT cost and capacity planners. In general, the system to be developed should be useful to managers at all levels of the OJT program from base level up through the Air Staff.

AFHRL Contact: James R. Burkett
AFHRL/LRTT
Lowry AFB CO 80230
Autovon 926-4388
Commercial (303) 370-4388

Title: Optimum Second-Generation Management Terminal Evaluation

Description: *The Advanced Instructional System* (AIS) is a computer-based instructional system employing both computer-aided instruction and computer-managed instruction techniques with a capability to train large numbers of students in different technical courses. A component of the system presently employed to deal with the human/machine interface for the computer-managed instruction portion of the system is referred to as a management terminal or B terminal. The B terminal is a specially fabricated device and was designed to provide a means for sending and receiving classroom information to and from a central site computer. The major components, which are secured in a desk-size cabinet, consist of an optical mark reader, a printer, a minicomputer, communications circuitry, and the necessary indicator lights and communication panels. The minicomputer controls the communication and necessary protocol between the other components. After the initial fabrication of the B terminal, the major components or replacement parts for them either became unavailable or



Staff Programmer Tryout Demonstration of Materials for the Training and Performance Support System Being Developed for Electronic Systems Division

very difficult to replace. Thus, it has become necessary to consider replacement configurations for at least the major components of the terminal if not the entire terminal. To ensure that any replacement configurations considered will fulfill current needs of the AIS and will consist of equipment that will be available in the future, it was necessary to examine present user requirements of the AIS and to perform a market analysis of available devices to fulfill such requirements. The results of these two tasks are documented in Denver Research Institute TRs — DRI Number 2701, *An Analysis of Computer Based Instructional System Peripherals;* and Number 2702, *An Analysis of CBI Data Requirements by Use of the Advanced Instructional System.*

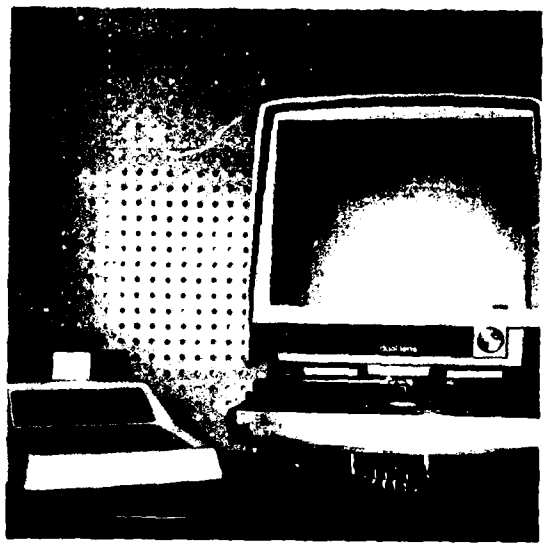
Utilization: The two studies revealed that computer-managed instruction systems are strongly influenced by circumstances and requirements peculiar to each user of the system. Also, no major technological advance is expected in the near future. The recommendation was to consider a family of terminal types as a possible B terminal replacement. The functional analysis documented the feasibility of achieving equivalent student management and instructional tasks as present with alternative forms and terminal types.

The primary outcome of this effort will be identification of a replacement configuration for the existing B terminal: one that has improved reliability and maintainability. The hoped for spin-off would be greater user acceptance of both the management terminal concept and the total computer-based instructional system. There is a good possibility that the per-copy cost of the replacement configuration could in the aggregate represent a considerable savings over the current B terminal configuration when total life cycle costs are considered.

AFHRL Contact: Alan P. Marshall
AFHRL/LRTA
Lowry AFB CO 80230
Autovon 926-2971
Commercial (303) 370-2971

Title: Development of Testing and Instructional System Based on Microterminal and Microfiche Devices

Description: Prior research (reported in AFHRL-TR-78-50, *Development of a Low-Cost, Stand-Alone Microterminal for Support of Testing and Instruction*) showed that the use of a small, inexpensive stand-alone terminal could be used to support testing in a computer-based system such as the Advanced Instructional System.



AFHRL Microterminal/Microfiche System For The Support Of Testing And Instruction

The advantage of such a terminal is both instructional and economic. Results to date indicate that the process of answering test questions using the microterminal rather than computer-readable test forms affects the speed and accuracy with which students complete a test. Over an appropriate amortization period, such as 5 years, a capital investment in low-cost terminals would effect a savings over the recurring material costs associated with test forms. The present research effort is directed toward extending the knowledge base about a new technology such as the microterminal. A basic design assumption for the microterminal was that computing power be focused on student responding rather than on the presentation of information. It was felt that for most instructional purposes, the presentation of information could be as effectively handled by more traditional means of off-line presentations, such as programmed texts. However, the powerful instructional technique of branching becomes difficult to implement with printed materials. For this reason, the two-dimensional accessibility feature of microfiche is seen as desirable. Additionally, in a large computer-based instructional system, the production of microfiche materials is a very direct process through the use of Computer Output to Microfiche (COM). COM production techniques were studied under a just completed effort, and the findings showed that COM was a feasible training technology. Conduct of the COM research was performed in the Weapons Mechanic Course at the Lowry Technical Training Center. The essence of the present effort is to combine the computer technology of the microterminal, which focuses on the control of

student responding, and microfiche technology, which provides ready access to diverse frame of instructional information. A hardware interface allows the microterminal to "know" which microfiche frame is being used by the student. In turn, the microterminal contains the instructional information on the microfiche. To be demonstrated at the end of this effort is a low-cost form of computer-assisted instruction and testing. In addition to the hardware development, much effort will be devoted to the pragmatics of designing and developing instructional and testing materials for the microterminal/microfiche system with an emphasis on process. The effort is directed toward designing a complete packaged system.

Utilization: Although the Microterminal/Microfiche System is only at the prototype stage, it is seen that fully operational units could be used in both resident and field training courses, for support of Extension Course Institute materials, and in large-scale testing operations, such as enlistment testing. Presently, plans are being made to support block level testing in a resident course at Lowry AFB. The potential benefits of this technology are the reduction of computer form costs for computer-based instruction, provision of interactive instruction for either computer or manually managed individualized courses, reduction in instructional materials costs through utilization of micrographics technology, and increased testing capabilities, including test security.

AFHRL Contact: Joseph Lamos
AFHRL/LRT
Lowry AFB CO 80230
Autovon 926-4386
Commercial (303) 370-4386

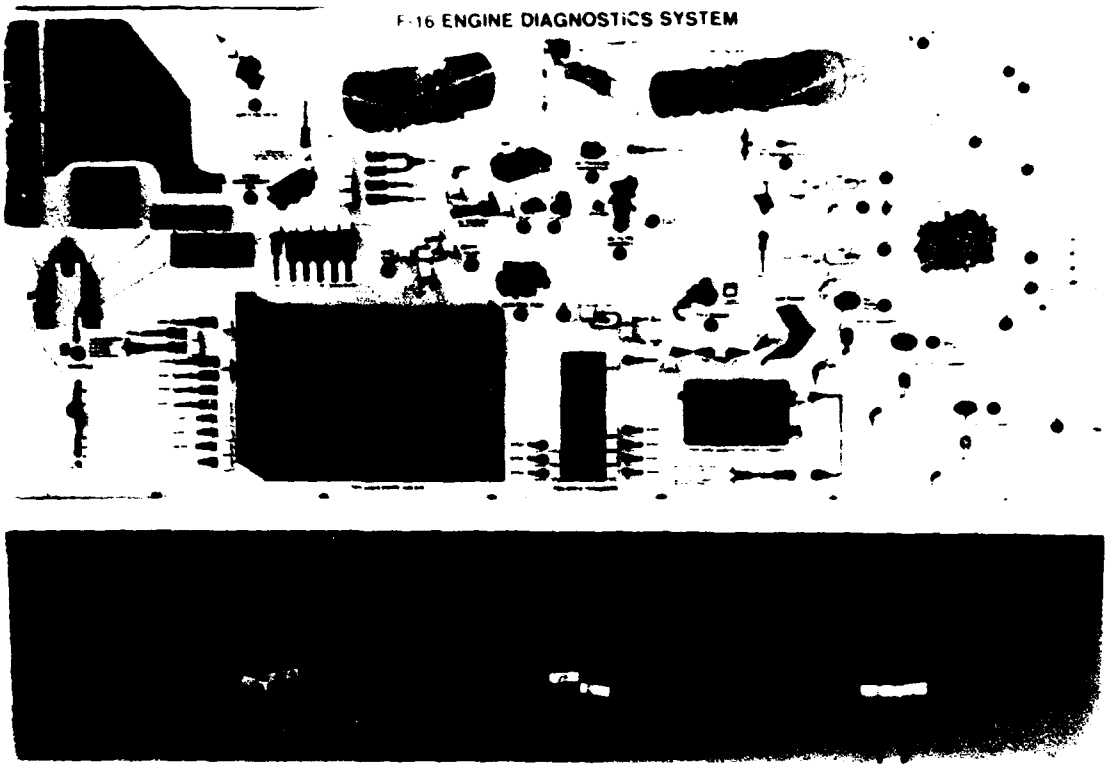
Title: F-16 Simulated Aircraft Maintenance Trainer Evaluation

Description: Current procurement projections include the planned acquisition of a number of state-of-the-art maintenance training simulators for organizational level maintenance training programs. The F-16 Simulated Aircraft Maintenance Trainers (SAMT) are the first devices of this type to be procured, and the F-16 Systems Program Office has requested that accurate information regarding the effectiveness of the equipment be obtained. This information is needed not only to assess the utility of the F-16 devices, but also to provide substantive information for the design, development, procurement, and evaluation of future weapon system maintenance training simulators. This information is to be obtained through the undertaking of a comprehensive evaluation conducted within an actual field setting.

The objectives of the evaluation effort are threefold. First, this effort attempts to empirically estimate the actual training and cost-effectiveness of several selected SAMT devices. Second, this effort attempts to develop and refine an effective evaluation methodology which may be employed in future assessments of similar maintenance trainer simulations in the Air Force. Third, this effort investigates the training and cost-effectiveness of specific design options/instructional features of the devices. The evaluation is to be accomplished in two phases. In Phase I, which is currently underway, a comprehensive evaluation model is developed which addresses the major training and cost impacts of the incorporation of the pneudraulic, engine start, engine diagnostic, flight control, electrical and engine operation SAMT devices into specific field training curricula. Also in this Phase, task proficiency data collection instruments are constructed and data analysis methods are defined. During Phase II, data collection activities will be undertaken at Hill AFB, where an assortment of SAMTs have been installed. The data will be analyzed and the findings will be reported.

Utilization: The information gathered in this study will do much to document for the F-16 SPO and for other maintenance simulation acquisition managers the lessons learned in this first major application of simulation in maintenance training. Furthermore, an explicit series of procedures for the assessment of cost and training effectiveness will be assembled in a handbook for use by future evaluators. Finally, an empirical data base will be established for future designers regarding the relative design costs incurred and training benefits achieved from two instructional features frequently considered in simulator designs, namely procedure monitoring and malfunction insertion.

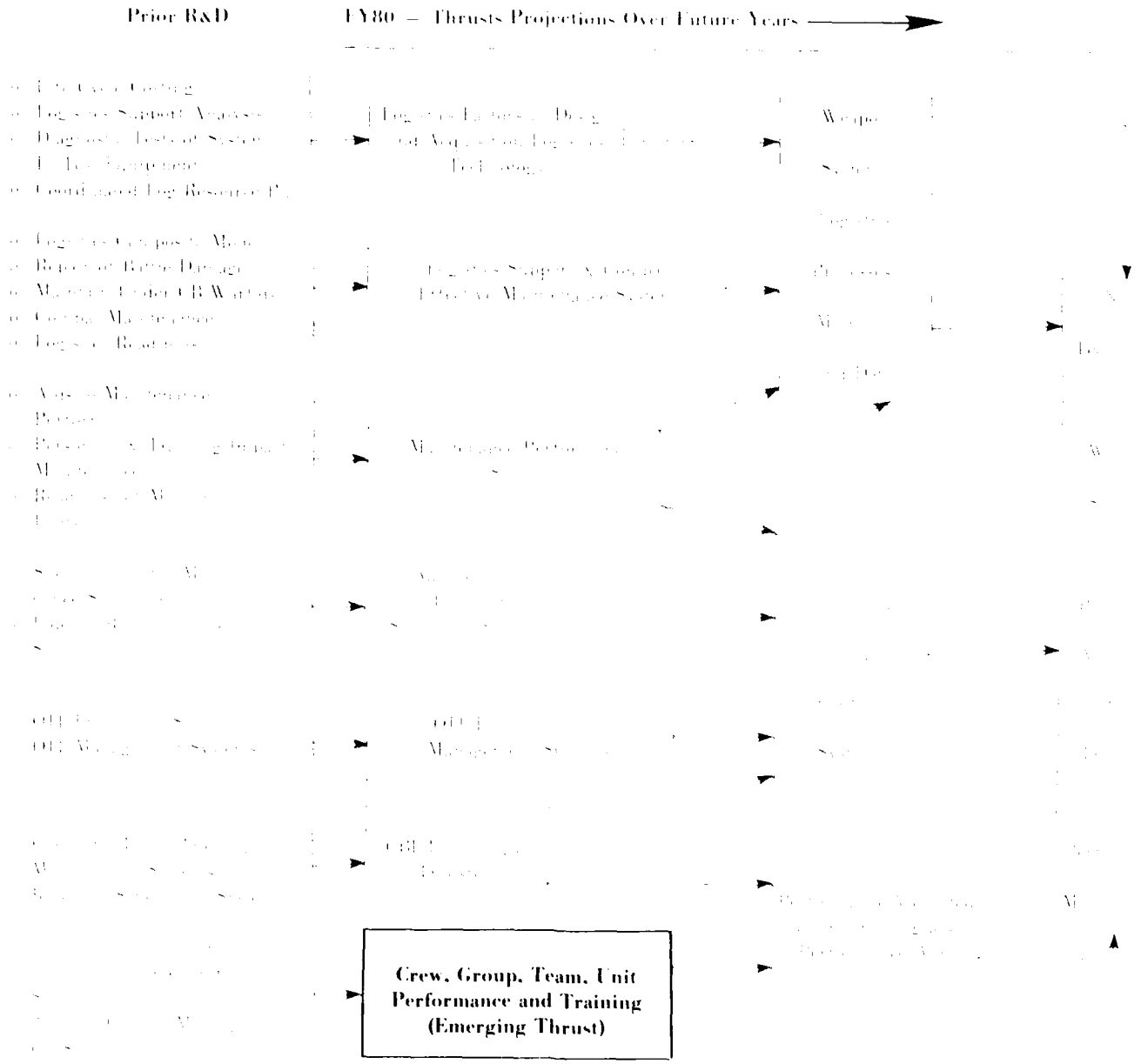
AFHRL Contact: Capt Philip A. Irish, III
AFHRL/LRTI
Lowry AFB CO 80230
Autovon 926-4386
Commercial (303) 370-4386



Engine Diagnostics SAME

Engine Start SAME

CREW, GROUP, TEAM, AND UNIT PERFORMANCE AND TRAINING*



* As noted in the Chief Scientist's report and thrust area descriptions, the Crew, Group, Team, and Unit Performance and Training Thrust is an emerging effort. Consequently, for this thrust, no technical achievements are reported. However, prior R&D associated with this thrust are listed above, and two ongoing R&D efforts are described subsequently.

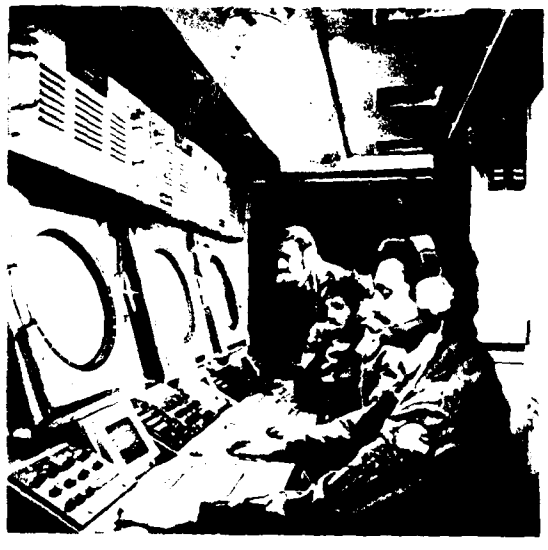
Title: Team Training for Operators of Command, Control, and Communications Systems

Description: The primary objective of this program is to provide the Air Force with baseline data relating to advanced training and simulation methods for enhancing team performance. The first step in accomplishing this goal is to survey existing Air Force team training programs in order to describe their strengths, identify areas of need, and survey the personnel, training, and equipment requirements of developing Command, Control, and Communications (C^3) systems. Information obtained from interviews with developers, managers, instructors, and students and information from observations of ongoing training will be combined with information from other sources (e.g. course materials, literature reviews, and existing data) to provide one basis for identifying and prioritizing elements within team training programs that demonstrate the greatest potential for improvement.

Utilization: This research will result in (a) recommendations regarding the potential utility of simulation technology in the C^3 team training (T^2) area, (b) recommendations regarding those training issues within the C^3T^2 area that can be solved or improved using currently available or refined technology, and (c) specific recommendations for subsequent C^3T^2 experimental research efforts which should be undertaken in order to address major problem areas identified during the data analysis that cannot be adequately addressed with current training technology.

A follow-up Phase II of this program will use the information developed in Phase I to develop, demonstrate, and evaluate techniques and methods to alleviate those C^3T^2 problem areas which are amenable to solution with currently available and/or refined technology. These solution techniques will be incorporated into a source/reference book that will permit direct transition of the solutions, techniques, and methods to operational management and training personnel for their use in dealing with major C^3T^2 problem areas.

AFHRL Contact: Roland Denson
AFHRL/LRLG
Wright-Patterson AFB OH 45433
Autovon 785-5910
Commercial (513) 255-5910



Tactical Air Command Control And Communications Team In Operation

Title: Three-Dimensional Display for Training Weapons Directors

Description: The basic objectives of this effort are to improve the performance and to reduce the training time of weapons directors. The enabling objective is an enhanced capability to teach air intercept geometry, situational awareness, and area control/tactics to student ground control weapons directors. The enhanced training capability is especially aimed at teaching the trainees to conceptualize and interact effectively with objects moving in three-dimensional space. The effort has four major steps: (a) develop and test special graphics system hardware and software to achieve the required display content and flexibility, (b) develop and conduct a small scale review of instructional materials, integrate the device into the training syllabus and develop examples and "mini-training" program, (c) demonstrate and evaluate the training impact and effectiveness of the system using operational personnel, and (d) document the effort.

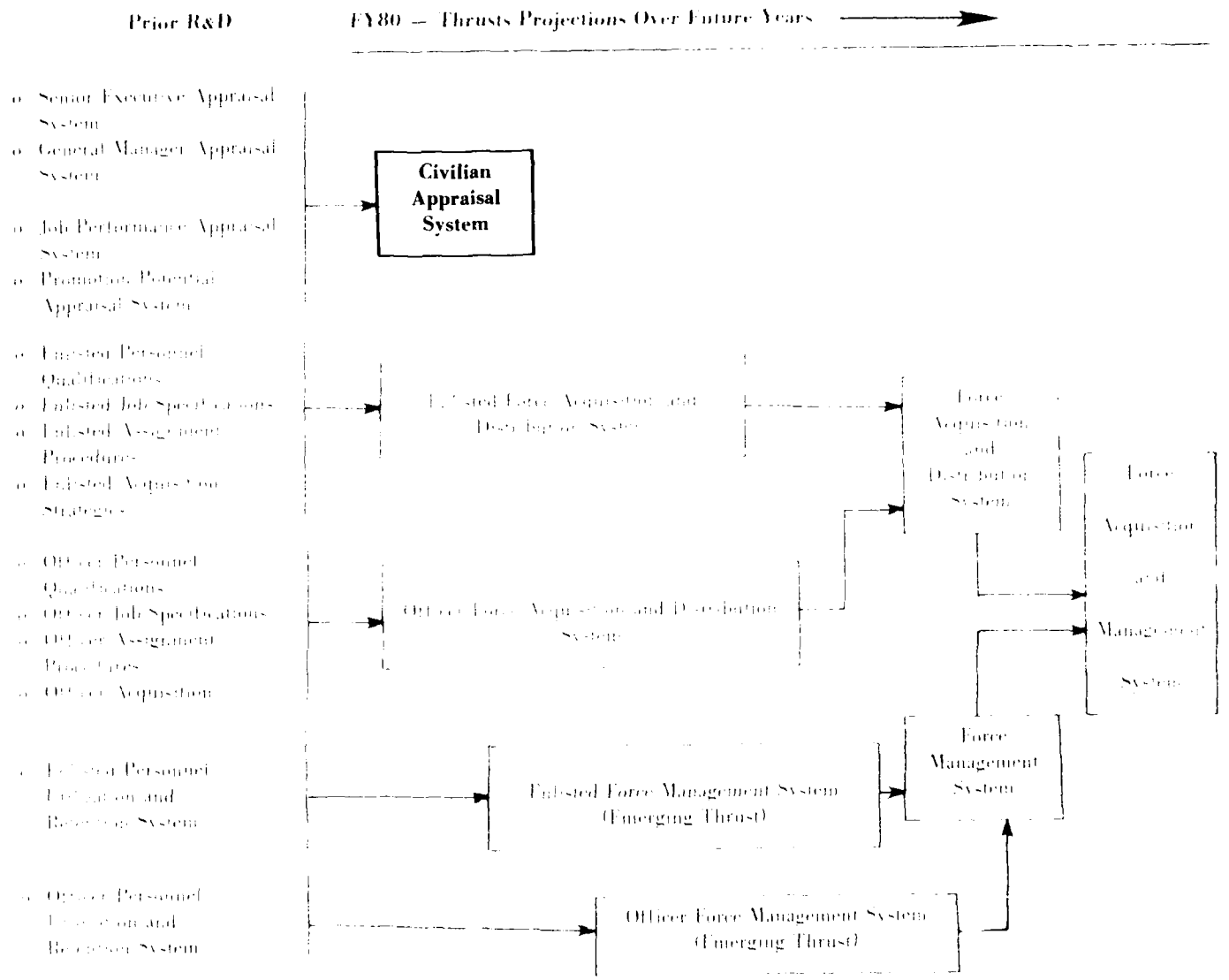
Utilization: This research will result in a training program and software/hardware configuration that can result in significant improved performance of weapons directors and reduced training time. Specifically, better performance from weapons directors on a critical aspect of ground controlled air intercept and reduced training time can save money and expand the population of personnel who can achieve the performance criteria for effective operational performance.

AFHRL Contact: Lawrence Finegold
AFHRL/LRLG
Wright-Patterson AFB OH 45433
Autovon 785-5910
Commercial (513) 255-5910

3-Dimensional Display Undergoing Development For Training Weapons Directors

MANPOWER AND FORCE MANAGEMENT

CIVILIAN APPRAISAL SYSTEM



Title: Senior Executive Appraisal System Development

Description: Senior Executive Appraisal System (SEAS) procedures, forms, members' and supervisors' training programs and materials, and performance review board procedures for ranking candidates and recommending bonuses were developed. Senior Executives and their supervisors participated in the developmental field tests and policy capturing exercises.

Utilization: Approximately 165 Air Force senior executives (GS-16s and above) now have objective performance plans spelling out tasks and standards to be met over 12-month periods. Their performance ratings will determine future assignments, dollar bonuses, and even retention.

Benefits: With SEAS, the Air Force met the legal requirements of the Civil Service Reform Act of 1978 and has an objective performance evaluation system which is designed to foster and reward excellence in performance.

AFHRL Contact: Bruce Gould
AFHRL/MOAP
Brooks AFB TX 78235
Autovon 240-3570
Commercial (512) 536-3570

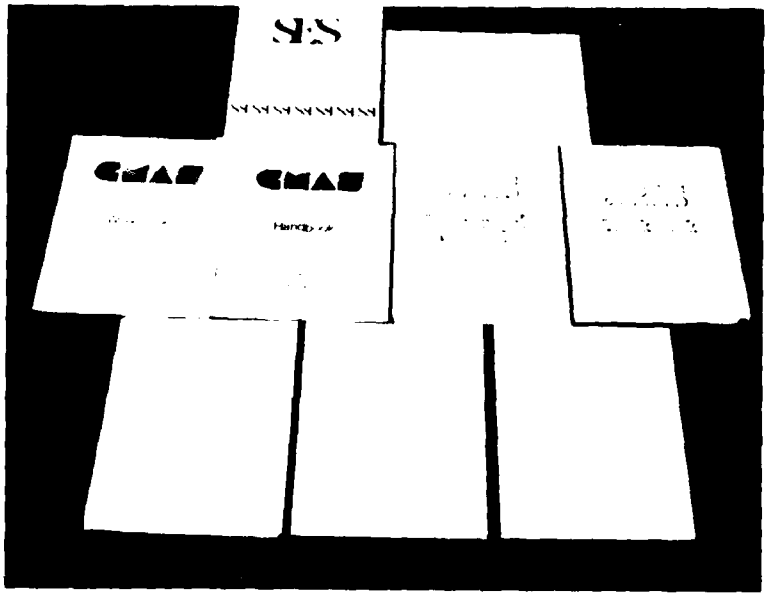
Title: General Manager Appraisal System Development

Description: General Manager Appraisal System (GMAS) procedures, forms, members' and supervisors' training programs and materials, and procedures for defining merit pay units and awarding merit pay were developed. General managers and their supervisors participated in the developmental field tests and provided the data base for the computer simulation models which developed and tested the guidelines for establishing merit pay units and the software procedures for determining and awarding merit pay.

Utilization: Approximately 11,000 Air Force general managers (GS-13 through GS-15 supervisors and management officials) now have objective work plans consisting of specific job elements and standards. The performance appraisals will be used as a basis for recognizing and rewarding quality performance by varying merit pay adjustments, for promoting, and for making training, retraining, and retention decisions.

Benefits: With GMAS, the Air Force met the legal requirements of the Civil Service Reform Act of 1978 and has an objective management system which is designed to foster and reward excellence in performance and to identify and remedy below-standards performance.

AFHRL Contact: Bruce Gould
AFHRL/MOAP
Brooks AFB TX 78235
Autovon 240-3570
Commercial (512) 536-3570



Civilian Appraisal Material

Title: Development of an Appraisal System for USAF Civilian Personnel

Description: The development of a comprehensive management system for encouraging excellence in job performance of Air Force civilian employees is underway. The system has four major components: (a) Senior Executive Appraisal System (SEAS), (b) General Manager Appraisal System (GMAS), (c) Job Performance Appraisal System (JPAS), and (d) Promotion Potential Appraisal System (PPAS). Under SEAS, bonuses will be distributed to senior executives based on job performance evaluations. SEAS was implemented 1 October 1979. A similar system for evaluating general managers (GMAS, GS-13 through GS-15) and distributing merit pay among these managers was developed and became operational 1 October 1980. Non-executives and non-general managers will be evaluated by JPAS which is under development and scheduled for implementation on 1 October 1981. JPAS uses a supervisor/worker developed work plan which identifies the major elements of the job which are to be rated, shows the criticality and relative importance of the elements, and states the performance standards for each element. The promotion potential system (PPAS) is also under development and will be used to rank order all GM, GS, and Federal wage grade promotion eligibles. Experts in each vocational area have defined behavioral dimensions necessary for performance in their area, and policy capturing exercises have produced mathematical algorithms for use in the ranking process. PPAS will be implemented 1 October 1981. Although the requirement for the job performance and promotion efforts predate the Civil Service Reform Act of 1978 by 2 years, the evolved systems are in accord with the requirements of that act.

Utilization: The results of this effort will be used for all civilian employees throughout the Air Force. It will be the basis for selection for promotion, special assignments, training, award of special pay, and other personnel actions. This system will permit management and career development of the civilian workforce based on the results of experimental studies. It is believed that, over time, this system will be seen as responsive to the needs of both management and employees.

AFHRL Contact: Bruce Gould
AFHRL/MOAP
Brooks AFB TX 78235
Autovon 240-3570
Commercial (512) 536-3570

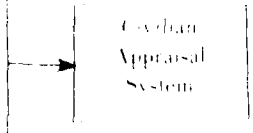
Staff Working on Civilian Appraisal Instruments

FORCE ACQUISITION AND DISTRIBUTION SYSTEM

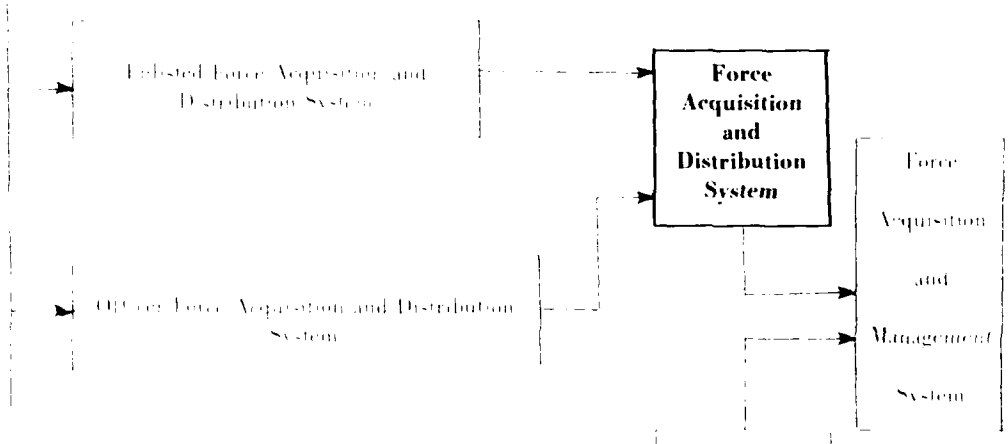
Prior R&D

FY80 — Thrusts Projections Over Future Years ⟶

- Senior Executive Appraisal System
- General Manager Appraisal System
- Job Performance Appraisal System
- Promotion Potential Appraisal System

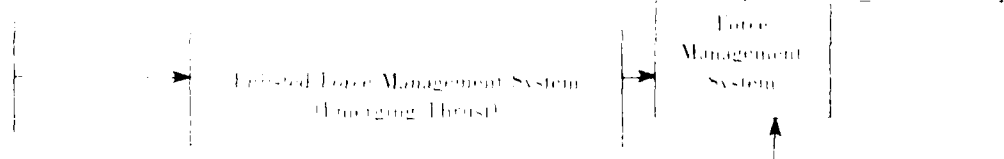


- Enlisted Personnel Qualifications
- Enlisted Job Specifications
- Enlisted Assignment Procedures
- Enlisted Acquisition Strategies

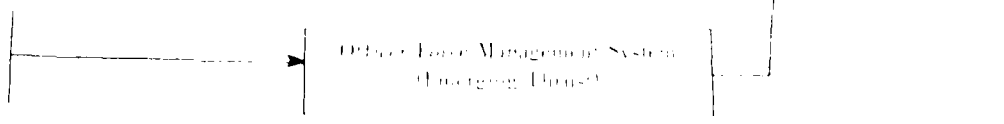


- Officer Personnel Qualifications
- Officer Job Specifications
- Officer Assignment Procedures
- Officer Acquisition

- Enlisted Personnel Utilization and Retention System



- Officer Personnel Utilization and Retention System



Title: Development of Armed Services Vocational Aptitude Battery Forms 8, 9, and 10

Description: A new prototype for the Armed Services Vocational Aptitude Battery (ASVAB) was developed by the ASVAB Working Group. This prototype was based on Air Force and other service validations of the ASVAB against technical school criteria and analyses of characteristics of the service applicant pool. The result was changes in both content and psychometric characteristics of the battery. From the new prototype descriptions, forms 8, 9, and 10 of the battery were developed, and these were implemented operationally on 1 October 1980. Armed Forces Qualification Test (AFQT) components of the battery were lengthened and additional "easy" items were incorporated to enhance reliability of the battery for selection purposes. In addition, the AFQT portion of the battery was produced in six forms to reduce test compromise problems. Thus, ASVAB 8-A and 8-B contain different items in the AFQT subtests, but identical items in the other subtests. The same is carried through for forms 9 and 10.

Utilization: ASVAB is revised periodically in accordance with Air Force Regulations 33-6 and 35-8. Efforts are continuously directed toward making selection more effective. The ASVAB is used by all services for recruiting, selection, and classification of enlisted personnel.

Benefits: The ASVAB has enabled all the Armed Services to better select and classify enlisted personnel for service. There is no direct method to compute the total money saved by using ASVAB, in terms of reduced training attrition and in increased operational effectiveness. However, if a very modest 5% gain in effectiveness is assumed, the annual gain is equivalent to about 5,000 man-years, or the equivalent of about 30 million dollars.

AFHRL Contact: Malcolm Ree
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845

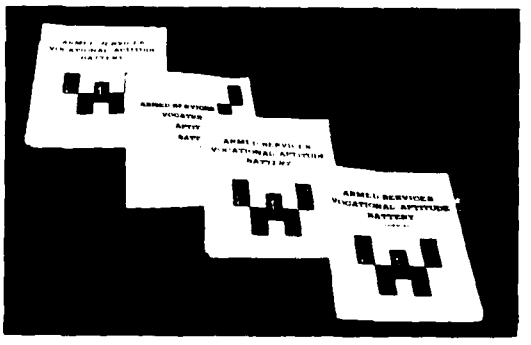
Title: Development of Air Force Reading Abilities Test

Description: The Air Force has not had a direct measure of the reading ability of Air Force personnel. As a result, individuals with reading difficulties are not identified until after they experience academic or job performance difficulties which are costly to the Air Force and may have an adverse motivational and career impact on the individuals involved. A brief reading assessment device is needed which can be administered to large numbers of individuals. The Air Force Reading Abilities Test (AFRAT) has been developed and validated against final school grade in 20 technical training courses. Officer and enlisted norms have been developed, equating scores to reading grade levels comparable to those produced by two civilian commercial reading tests.

Utilization: AFRAT scores can be used to identify those individuals who need remedial reading training before this deficiency is discovered through failure in training courses or on the job. These scores can also be used to evaluate the efficacy of remedial training courses in effecting better reading skills of course graduates.

Benefits: It is very costly to the Air Force to discover reading deficiencies only through failure of the individual to perform in school or on the job. By identifying such deficiencies early, the student can be provided remedial reading training prior to technical training.

AFHRL Contact: Ben Roach
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845



Armed Services Vocational Aptitude Battery Forms

Title: Item Characteristic Curve Parameters: The Effects of Sample Size on Linear Equating.

Description: This first-of-its-kind achievement investigates the effects of item analysis calibration sample size on the linear equating of item characteristic curves. Through a series of simulations with varying subsample sizes, the resultant errors of equating have been studied and delineated.

Utilization: This work demonstrated that linear equating was possible and could be used for the construction of specially calibrated item pools required for computerized adaptive testing.

Benefits: Results of this project provide a much needed advance in the state of the art of item pool construction. This study indicated that there are alternative, less expensive, and practical methods of providing norms for large groups of items without administering all items to all subjects.

AFHRL Contact: Malcolm Ree
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845

Title: Development of a Computerized Vocational Counseling System

Description: Research was accomplished under contract to develop a computerized system for administration, scoring, and interpretation of the Vocational Interest-Career Examination (VOICE), a self-report inventory useful in the airman classification process. A prototype system was developed including the hardware and software necessary for operation and the system was successfully field tested at Lackland AFB. Additionally, a comprehensive implementation plan was developed including cost and benefit analyses.

Utilization: Substantial time savings were realized for the computerized VOICE system over the conventional method of administration and scoring. Additionally, sources of human error were eliminated from the counseling process.

Benefits: A method for fast and easy administration of the VOICE was produced which would allow inclusion of individual's vocational interest data in the classification process as a routine procedure. This would increase the likelihood of enhanced job satisfaction, increased job productivity, and reduced attrition and turnover.

AFHRL Contact: Jeffrey Kantor
AFHRL/MODF
Brooks AFB TX 78235
Autovon 240-3648
Commercial (512) 536-3648

Title: Likelihood Function Estimation Model

Description: The prototype likelihood function estimation (LIFE) model was enhanced to reduce computer run time and to increase data handling capabilities. The LIFE model is now a useful analytical tool which can be used to model dependent dichotomous variables (such as pass/fail, promote/not promote) and be used to develop an improved operational selection and classification system.

Utilization: The LIFE methodology was used to develop a probability-of-attrition prediction for first-term Air Force enlistees. This prediction system formed the basis of a new Air Force eligibility criterion which is being operationally tested by Air Force Recruiting Service under Project IMAGE (Improved Minimum Airman

Guidelines for Enlistment). Under the new criterion, a certain number of prospective enlistees who did not meet current enlistment standards are permitted to enlist in the Air Force. Through the first year, the test showed that the LIFE model was able to classify enlistees correctly, thus allowing the Air Force to increase accessions without increasing first-year attrition. The Air Force has now extended Project IMAGE for a second year to allow recruits who do not meet current enlistment standards to enlist in the Air Force if they are qualified by the new eligibility criterion.

Benefits: Project IMAGE has demonstrated first-year savings of over $400,000 through reduced overall attrition rates. With the extension of the program, second- and third-year savings appear to be potentially larger. The LIFE methodology should be similarly applicable in all Air Force assignment situations.

AFHRL Contact: Janice Buchhorn
AFHRL/MOMD
Brooks AFB TX 78235
Autovon 240-3222
Commercial (512) 536-3222

Title: Methods for Collecting and Analyzing Task *Analysis Data*

Description: A Task Analysis Handbook (AFHRL-TR-79-45(II)) was developed to provide a validated set of procedures and guidelines for analyzing tasks into subtasks and supporting skills and knowledge. The handbook is designed for use in technical training by subject matter experts. It assumes that tasks have already been selected for training, that trainee proficiency levels have been determined, and that the trainee population is known. Three major stages of the task analysis procedure are contained in the handbook: (a) development of preliminary performance requirements, (b) identification of subtasks, and (c) identification of supporting skills and knowledge.

Utilization: The handbook is being used to train instructional system designers in formal courses conducted by Air Training Command. The handbook is expected to be formally published as part of AFP 50-58, *Handbook for Instructional System Designers.*

Benefits: Application of handbook procedures will result in better-targeted technical training with no added expenses for high-level course developers. The handbook complements and is compatible with the Navy's Instructional Quality Inventory and could prove useful in Navy instructional design efforts. The major benefits of the handbook are that the procedures have been validated and can be applied readily by subject matter experts. The procedures do not require sophisticated instructional technology expertise.

AFHRL Contact: Hendrick W. Ruck
AFHRL/MODS
Brooks AFB TX 78235
Autovon 240-3551
Commercial (512) 536-3551

Title: Evaluation of Aptitude Requirements of Air Force Jobs

Description: In an all-volunteer recruiting environment, particularly with a decreasing manpower pool projected for the 1980's, it is critical to ensure that minimal aptitude requirements not be overstated and that high level talent be allocated to jobs having the greatest difficulties. A methodology has been developed to assess job aptitude requirements which results in measures of learning difficulty for each Air Force job. Each measure of learning difficulty is based on task by task analyses of *learning difficulty* as well as the time spent by incumbents performing job tasks. The methodology has been applied to jobs in the Electronics, Mechanical, and General aptitude areas. In addition, research is being performed to determine the feasibility of using this methodology for determining perceptual/psychomotor job requirements.

Utilization: Results from this research regarding the realignment of aptitude requirements for approximately 180 Air Force jobs have already been provided to the Air Force Manpower and Personnel Center. Additional data from nine jobs will be available shortly. The findings of this project are also being implemented through the computerized job-offer system used by the Air Force Recruiting Service. A complete implementation package, including a comprehensive impact analysis, is currently being developed.

Benefits: There are three significant areas where cost avoidance should be achieved as a result of this research. Contingency plans for talent shortages will be available as a product of this effort. These plans will enable the Air Force to plan for talent shortages in any specific specialty or across all specialties. Another product will be a more

defensible position for aptitude requirements in the case of court actions. The present system, which excludes many individuals from entering Air Force jobs based on a cut-off aptitude score, has no objective data to support its use. This research will provide data on the learning load requirements for each job. Another product will be an improved match-up of Air Force talent and job requirements. Improving the match of talent with requirements can have positive effects on job attitude, retention, recruiting, and training.

AFHRL Contact: Joseph L. Weeks
AFHRL/MODS
Brooks AFB TX 78235
Autovon 240-3551
Commercial (512) 536-3551

Title: Assessment of Physical Strength and Stamina Requirements in Air Force Specialties

Description: Each Air Force enlisted specialty is presumed to differ in the nature and extent of physical capabilities required for successful job performance. Moreover, in a variety of specialties, effective performance requires above average physical strength and stamina from incumbents. Despite these prevailing conditions, little systematic research has been done to support definitive assignment criteria to ensure that personnel capabilities meet on-the-job requirements. A comprehensive assessment of the physical occupational requirements in the more than 230 enlisted specialties is presently underway. To date, approximately 16,000 supervisors have been surveyed for purposes of identifying, defining, and quantifying demanding tasks within specialties. Preliminary findings have shown that supervisory personnel can reliably identify and rate physically demanding tasks and thereby provide the empirical base for specialty-specific task demand profiles. These results will soon be documented in a technical report.

Ongoing and future research activities include the completion of a two-stage survey cycle for all enlisted specialties and the formulation of regression models to compare demand characteristics across specialties. Moderator variables such as numbers of first-termers performing the tasks, time spent in task execution, and consequences of inadequate performance will be closely studied.

Utilization: Physical demand indices will ultimately be incorporated into the Air Force Person-Job Match system as an additional factor to be considered for the optimal assignment of individuals to jobs. Further refinement of the algorithm with a physical demand factor is especially important in view of current accession trends: namely, declining numbers of qualified male enlistees and the concomitant increase in the proportion of females serving in the Air Force.

Benefits: Definitive physical job requirements can be expected to reduce recruiting costs by expanding the qualified applicant pool (particularly among females) and to curtail medical costs resulting from the assignment of persons to jobs where demands exceed physical capabilities. Specifications for entry into each enlisted career field will be sufficient to insure an optimum distribution of available talent.

AFHRL Contact: Sherrie P. Gott
AFHRL/MODS
Brooks AFB TX 78235
Autovon 240-3551
Commercial (512) 536-3551

Title: Kalman Filter Technology Transfer

Description: State-Space Forecasting and Kalman Filtering can be used to analyze many time-dynamic personnel problems, where regression analysis may not be appropriate. AFHRL, through contract, has developed these techniques and the software necessary for their application. Two short courses were sponsored by AFHRL on State-Space Forecasting and Kalman Filtering. In-house personnel developed interactive software for linear Kalman Filtering and Extended (nonlinear) Kalman Filtering.

Utilization: Application of Kalman Filtering in personnel research can greatly improve prediction accuracy in time-dynamic problems. AFHRL will use this technique in analyzing the input variables for the enlisted classification system, called the Person-Job Match system. Navy Personnel Research and Development Center personnel attended the short courses and are using these techniques and software from AFHRL.

Benefits: This work will provide the analysis techniques to improve and extend Laboratory capability in time-dynamic estimation problems such as retention and attrition.

AFHRL Contact: 1st Lt Dave Roberts
AFHRL/MOMD
Brooks AFB TX 78235
Autovon 240-3648
Commercial (512) 536-3648

Title: Implementation of a Person-Job Match System for Post-Enlistment Classification

Description: In December 1976, a computer-based enlisted classification system, the person-job match (PJM) system, was implemented for pre-enlistment classification. In FY 80, an improved and expanded PJM system was developed for post-enlistment classification and is close to being implemented operationally by ATC. This new system will classify approximately 40% of all recruits who require job classification during basic military training, while the pre-enlistment PJM classifies the other 60% who are classified into guaranteed Air Force jobs in the pre-enlistment environment. The improved system assigns a payoff value to each job for which a person is eligible, based on such factors as aptitude, job difficulty, interest, job preference, job criticality, cost of training, predicted attrition, education, and job fill. These payoff values are then used to classify individuals into their best skills. The PJM system is documented in AFHRL-TR-79-29, *Pre-Enlistment Person-Job Match System.*

Utilization: The post-enlistment PJM system will be used by the Air Training Command at Lackland AFB to classify approximately 40% of all Air Force recruits.

Benefits: This new classification replaces the existing PACE (Processing and Classification of Enlistees). The new system will classify trainees using a payoff algorithm based on more information than is available with the present system, which is based mostly on job-fill priority. Increased use of such information as aptitude-difficulty match and job interest should enhance longer-range job satisfaction and retention. The new system will make Basic Military Training classifications more automated, including routine management reports on the performance of the system.

AFHRL Contact: 1st Lt Dave Roberts
AFHRL/MOMD
Brooks AFB TX 78235
Autovon 240-3648
Commercial (512) 536-3648

Title: Air Force Enlisted Personnel Retention-Accession Model

Description: The purpose of this research was to develop a methodology for explaining trends involving Air Force accessions and retentions. The analysis was conducted in three stages. First, the life-cycle model of the enlistment decision originally developed in a previous effort was extended and clarified. Second, a new data set was developed. These data were examined and plotted to reveal their relation to significant institutional changes that occurred over the period from 1957 to 1978 and were then used to estimate accession supply equations for each sex, race, and Armed Forces Qualification Test (AFQT) category. Third, two new theoretical developments were presented. The first of these develops a model of the enlisted force by skill group. The second utilizes the theory of economic dynamics to simulate the adjustment of the enlisted force to changes in pertinent variables. The methods of analysis and results of this effort are documented in AFHRL-TR-80-12, *Air Force Enlisted Personnel Retention-Accession Model*, published in June 1980.

Utilization: Results of this research will be used in the subsequent development of an Air Force National Skills Market Model. Its basic purpose will be to provide Air Force policy makers and decision makers with the capability to determine the impact on accessions and retentions resulting from the interaction of Air Force policies and economic, demographic, and environmental conditions.

Benefits: Enlisted supply is a complex issue that will become increasingly important throughout the next decade as the pool of eligible youth declines. The insights gained from this research are already being used by Air Force Military Personnel Center/Operations, Plans, Programs and Analysis in the preparation of the FY 82 Program Obligation Memorandum submission.

AFHRL Contact: John Taylor
AFHRL/MOMD
Brooks AFB TX 78235
Autovon 240-3222
Commercial (512) 536-3222

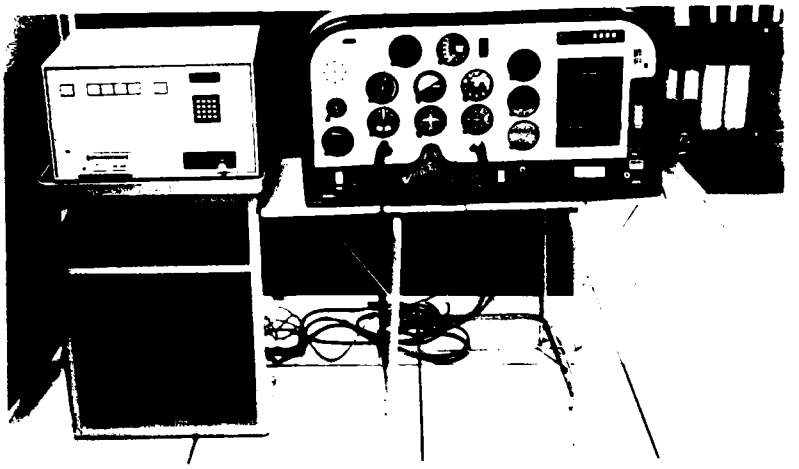
Title: Development of Portable Pilot Aptitude Measurement System

Description: During August of 1980, two devices designed for fully automated field-site testing of pilot applicants were delivered to the Air Force Human Resources Laboratory. During the three-hour test sequence, the applicants are given a detailed course in the operation of a light-plane flight simulator and are taught to perform basic flight maneuvers, such as straight-and-level flight, turns, and climbs and descents. Following each instructional sequence, the applicants are tested and their performance automatically evaluated by an on-board microprocessor system. This system generates performance summaries and an overall performance score, which may prove useful in the selection of personnel for flight training. The portable pilot aptitude measurement system is now undergoing evaluation, along with other selection instruments developed by this Division.

Utilization: This work is a follow-on from earlier General Aviation Trainer studies conducted at the Division. These studies demonstrated predictive utility for aviation *learning samples*, but the equipment was both expensive and cumbersome. These devices, on the other hand, are portable and may make use of learning samples feasible for pilot selection.

Benefits: Use of the portable pilot aptitude measurement system may materially reduce attrition from undergradate pilot training and may prove applicable to the problem of classifying individuals into differing training tracks.

AFHRL Contact: David R. Hunter
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845



Portable Pilot Aptitude Measurement System

Title: Advanced Research on Adaptive Testing Systems

Description: Traditionally, in the Air Force and elsewhere, uniform standardized aptitude tests have been given to employment applicants. These tests must be fair and accurate, they must be valid for predicting some meaningful criterion such as training school grades or on-the-job performance, and they must be as economical as possible. When the same test is administered to every applicant, accuracy of measurement is limited to a range around the mean score of those taking the test. A test, as ordinarily constructed, cannot be accurate along its entire range, without being so long that it would be impractical to administer. Adaptive testing is a technique for presenting from a large pool, a small subset of items selected according to how the examinee has responded to previous items from the pool, thereby avoiding the presentation of inappropriate noninformative items. Live testing of subjects and theoretical simulation are both being used in research on this important technique. Several studies have been completed and several others are underway. The Air Force Human Resources Laboratory is a recognized leader in this field, and Dr. Malcolm Ree, the responsible task scientist, has received the Air Force Association's Dan Berkant Award for his research. A series of efforts are underway to investigate facets of Latent Trait Theory, such as what factors affect linear equating of item characteristic curve parameters and how valid simulations are for studying Latent Trait Theory issues. Additionally, studies in practical issues in adaptive testing, such as sample size, estimation techniques, validity, and item pool entry, are underway in simulation and live data studies. Finally, the development of initial item pools for field use is continuing.

Utilization: Adaptive testing is usually based on Latent Trait Theory, and serious gaps exist in the body of theoretical knowledge. These efforts are directed at completing the knowledge as it applies to the Laboratory's responsibility to the Joint Services Computer Adaptive Testing Interservice Coordinating Committee. This research is necessary to achieve the necessary tasking under this commitment. Adaptive testing will eventually be used in developing and norming Air Force operational aptitude tests and by the Air Force Recruiting Service and the Army Military Enlistment Processing Command.

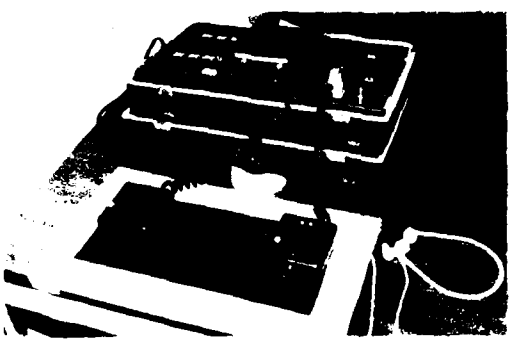
AFHRL Contact: Malcolm Ree
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845

Title: Development of Replacement Forms of the Armed Services Vocational Aptitude Battery (ASVAB)

Description: In late calendar year 1982, new versions of the Armed Services Vocational Aptitude Battery (ASVAB) may be required for operational implementation. In addition, various follow-up analyses of ASVAB forms 8, 9, and 10 will be necessary, both for battery maintenance and to provide input to development of follow-on forms. Item development for new forms has been initiated under contract. A large scale Initial Operational Test and Evaluation of forms 8, 9, and 10 is in progress and is designed to verify the appropriateness of norms for forms 8, 9, and 10 and to detect problems in operational use. As appropriate data mature, analyses will be initiated to assess the relationship of ASVAB forms 8, 9, and 10 scores to Air Force criteria of interest. These studies, along with similar ones in the other services, will provide guidance for development of follow-on forms.

Utilization: ASVAB is revised periodically to maintain integrity of the battery and to incorporate improvements. It is used by all of the Armed Services to select and classify enlisted personnel.

AFHRL Contact: Malcolm Ree
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845



Zero-Input Tracking Analyzer Used In Pilot Selection Research

Title: Development and Calibration of Enlistment Screening Test Forms 7 and 8

Description: The Enlistment Screening Test (EST) was originally designed by the Laboratory as a short pre-screening instrument for use by Air Force recruiting detachments. Recent events make updating the EST necessary. The content of selection tests, such as the Armed Forces Qualification Test (AFQT) has changed, and other services are also using the EST. New EST forms are being developed, and these will closely match the content of the current AFQT and contain items which better discriminate among applicants around AFQT cut-off scores of the various services. New EST tests will be calibrated in a field study on applicants.

Utilization: The EST will be used by recruiting detachments of all the Armed Services. It will reduce administrative costs by identifying enlistment candidates who are likely to fail the operational selection tests, thus reducing travel expenditures.

AFHRL Contact: John Mathews
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845

Title: Perceptual-Motor Ability Measurement

Description: Numerous studies, particularly those conducted during World War II, have indicated that tests using apparatuses of various sorts can make significant contributions to personnel selection, even when added to conventional paper-and-pencil tests. These tests are called perceptual-motor tests. They were dropped from the Air Force inventory of tests about 20 years ago, because they were very expensive to manufacture, to administer, to maintain, and to keep calibrated. The advent of solid-state electronics and low-cost computer terminals has eliminated most of the difficulties inherent in earlier equipment and has brought about a rebirth of interest in the use of perceptual-motor measures in the selection of Air Force personnel. The use of two tests of psychomotor coordination for the selection of pilot trainees is now being evaluated. This testing program will continue and other tests of perceptual-motor abilities will be developed and evaluated. Measures obtained in computer-controlled flight simulators are also being developed and evaluated, which indicate how quickly and how well an individual can learn to perform a task requiring integration of several perceptual-motor abilities. Studies also will evaluate procedures for the assessment of perceptual-motor abilities and relate those abilities to performance in Air Force technical specialties. These studies include exploratory development of test measures and the evaluation of the psychometric properties of those measures, and applications studies which seek to assess the validity of those measures for selection and classification.

Utilization: Perceptual-motor tests may be used by recruiting and assignment agencies and by Air Training Command for the selection and classification of both enlisted personnel and officers. The use of tests of perceptual-motor abilities will result in the reduction of attrition from training and a corresponding reduction in training cost.

AFHRL Contact: David R. Hunter
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845

Automated Measurement System Test Stations

Title: Task-Oriented Measurement Technologies

Description: Research is being conducted across a broad number of areas to address important technology-related problems. They are to identify and develop methodologies for clustering or otherwise determining underlying dimensionalities of occupational tasks, identify and develop optimal rating scales for measuring technical jobs, develop procedures for analyzing complex rating patterns involving multiple interrelated policies, and develop models for predicting job requirements based on available data.

Utilization: Advances in task-oriented measurement may impact instructional systems design, occupational measurement techniques, classification structure, and assignment procedures. Advances could result in more accurate training and assignment decisions, resulting in a more effective force.

AFHRL Contact: Hendrick W. Ruck
AFHRL/MODS
Brooks AFB TX 78235
Autovon 240-3551
Commercial (512) 536-3551

Title: Economic Cost of First-Term Enlisted Force

Description: The overall objective is to identify and compile a comprehensive data base of cost and economic parameters sufficient to answer economic and operational questions about the first-term enlisted force. These costs will include such items as the fixed, variable, average, and marginal costs of recruiting, training, attriting, and reenlisting a first-termer, as well as the institutional costs of maintaining the first-term force. In the final phase the research will explore data deficiencies and offer suggestions for cost determination which are the best approaches for meeting Air Staff goals and needs.

Utilization: Various Air Force agencies concerned with the problem will use the results to provide policy makers and planners with a set of economic data for judging the economic impact of various policy changes, thereby improving the information base for the decision making process. The approach will entail an economic look at the flows of the first-term force with an application toward making the job of the decision maker easier and more precise.

AFHRL Contact: Virman Kim Davis
AFHRL/MOMD
Brooks AFB TX 78235
Autovon 240-3222
Commercial (512) 536-3222

Title: Kalman Filter Prediction of Time Series Based on State-Space Models

Description: Time series analysis is a vital statistical tool in many areas of personnel research where regression analysis is not appropriate. State-Space Forecasting and Kalman Filtering can be used to analyze many time-dynamic personnel problems. Through contract, the Air Force Human Resources Laboratory has developed these techniques and the software necessary for their application and is using these methods to analyze and predict the input variables for the Person-Job Match (PJM) system used for enlisted classification. In addition, Kalman Filter models for predicting enlisted retention will be developed. The forecasting system is documented in AFHRL-TR-79-33, ***Recursive Forecasting System for Person-Job Match.***

Utilization: These analysis methods may greatly improve prediction in the retention areas which have been difficult to predict. In addition, improved prediction for the PJM system will greatly improve the optimal job classification of enlisted recruits.

AFHRL Contact: 1st Lt Dave Roberts
AFHRL/MOMD
Brooks AFB TX 78235
Autovon 240-3648
Commercial (512) 130-3648

Title: Estimation of Air Force Enlisted Manpower Supply

Description: The basic tasks to be accomplished by this effort are the development of a data file and its subsequent use in developing military manpower supply theories and related econometric equations. These products will then be used for the estimating and hypotheses testing required to determine the relation between certain economic and policy variables and Air Force enlisted accessions and retention rates. A major factor in the success of this effort will be the quality of the data used in the empirical estimation. Important variables such as civilian wage rates, levels of employment and other nonmilitary type economic data are readily available in the civilian sector. On the military side, it is anticipated that various cohorts of Air Force accessions will be traced from AFHRL data files covering the period from 1957 through 1979. (This effort will be based upon, and extend, a methodology developed under previous research sponsored.)

Recruit Experimental Testing

Utilization: Quantitative relationships between the parameters and the accession and retention of Air Force enlisted personnel will be derived. An analysis will be made to determine the most appropriate level for studying the Air Force competition by specific occupation or industrial grouping. Results of this effort will provide the Air Force with consistent estimates of military manpower supply on which to base policy decisions. The following organizations have been briefed on this effort and have expressed a real need for the expected research results: Officer/Enlisted Retention, Recruiting Service, and Airman Analysis Branch.

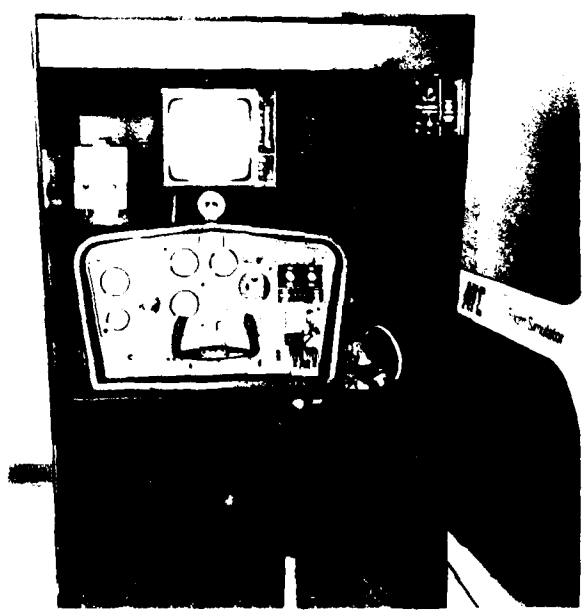
AFHRL Contact: John Taylor
AFHRL/MOMD
Brooks AFB TX 72835
Autovon 240-3222
Commercial (512) 536-3222

Title: Selection for Rated Training (Pilot and Navigator)

Description: For many years, the Air Force Officer Qualifying Test (AFOQT), Pilot Composite, has been the primary selection variable for entry of pilot and navigator candidates into undergraduate flying training pilot and navigator programs. A program is underway to determine the feasibility of using newly devised perceptual-motor test scores and performance on a portable desk-top flight simulator to improve pilot selection. One segment of research in this area calls for administration of tests on this new equipment to large samples of pilot qualified students from Air Force Academy, Reserve Officers Training Corps, and Officer Training School commissioning sources. Another large segment involves an extensive evaluation of the Air Force Flight Screening Program. In recent years, the Undergraduate Navigator Training (UNT) program has experienced an unusually high attrition rate. The Navigator-Technical composite for the AFOQT was considerably revised in an effort to ameliorate the problem, but additional research is needed. An experimental Basic Navigator Battery has been developed and administered to 16 UNT classes. The scores from the Navigator Battery and the Officer Qualifying Test will be compared with performance in Navigator Training, in advanced courses, and on-the-job performance after 1 year in an operational role.

Utilization: The new selection system will be used by Air Training Command. The selection procedures developed should be useful to Air Training Command in improved selection decisions for pilots and navigators. Attrition from any training school is always very expensive, and this is particularly true for those schools training rated officers. Improvement of the pilot and navigator selection systems should reduce attrition from the Pilot Training and Navigator Training Programs and assist in the identification of superior pilots and navigators in an operational squadron.

AFHRL Contact: Jeffrey Kantor
AFHRL/MODF
Brooks AFB TX 78235
Autovon 240-3648
Commercial (512) 536-3648



Experimental Pilot Selection Device

Title: Development and Validation of Officer Selection and Classification Tests

Description: The development of a new form of the Air Force Officer Qualifying Test (AFOQT-O) will be completed, and the test is scheduled for implementation in 1981. Analyses of new data bases may dictate some major changes to the structure of the test, such as division of the test into two separate portions (general aptitudes and special aptitudes), changes in length of some subtests, and/or the substitution of some scales. An extensive validation study of AFOQT-N is underway, using Officer Training School students. They will be tracked through this school and through technical school, as well as through their first year on the job. Later, personnel from the Air Force Academy and Reserve Officers Training Corps will be similarly tracked. These studies, along with aircrew selection studies, will provide a basis for development, later, of AFOQT-P.

Utilization: This research should result in a better selection and classification system for all officer personnel, which will be used by all officer personnel procurement/classification functions in the Air Force. The Air Force will benefit from this research program through lower officer training attrition and improvement in the quality of the officer force.

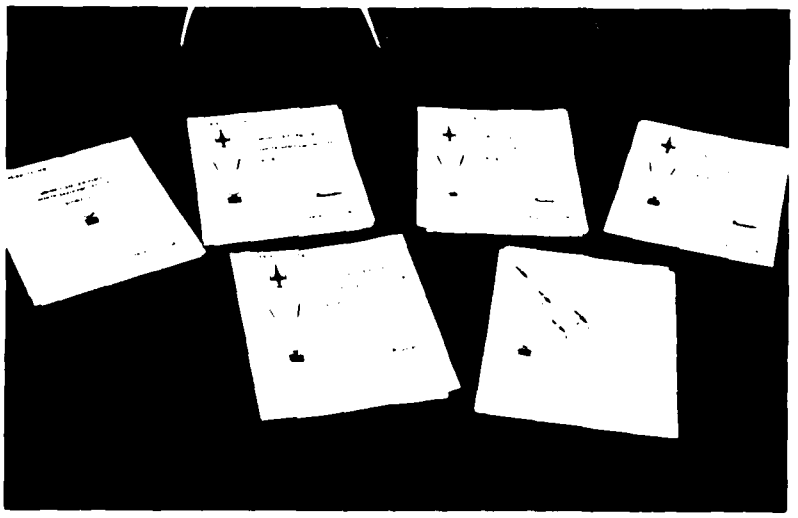
AFHRL Contact: Ben Roach
AFHRL/MOAM
Brooks AFB TX 78235
Autovon 240-3845
Commercial (512) 536-3845

Title: Voice Spectral Analysis as a Measure of Stress in Air Combat

Description: Available methods of assessing operator stress (experienced as subjective feelings such as pressure, tension, and strain) have certain disadvantages which mediate against their use in many high stress situations. In particular, available methods have very limited applicability for assessing stress in airborne aircrew operations where no interference in task performance is tolerable, and post hoc measures provide a poor assessment of stress-task relationships. Recent literature suggests that the analysis of the spectral qualities of an operator's voice output can provide an unobtrusive, real-time indicator of the operator's stress level. The objectives of this research are to investigate the relationship between stress and voice output of aircraft operators and to develop a system of stress quantification, which can be used either in historical (via recorded sample) or real-time modes and is based upon voice output analysis. The data base used in this study will be composed of audio-recordings from actual combat operations, aircraft accidents, and aircraft incidents.

Utilization: A valid, unobstrusive measure o operator stress would provide a means of assessing an i 'dual's stress management capabilities which are cr d in a variety of military operations. Additionally, stress measure would serve as a useful iterion fc. stress training and reduction studies.

AFHRL Contact: Jeffrey Kantor
AFHRL/MODF
Brooks AFB TX 7823.
Autovon 240-36'8
Commercial (512) 536-3648



Air Force Officer Qualifying Test

Title: Enhancement of Officer Survey Technology

Description: The technology developed for Air Force enlisted specialties, Occupational Survey/Comprehensive Occupational Data Analysis Programs (OS/CODAP), has produced sizable benefits for the Air Force over the years. Empirically derived job indices have guided decision makers in such areas as classification and occupational structure, training requirements, and personnel assignments. Comparable occupational survey technology for officer specialties is still in the formative stages, however. The need exists to improve the measurement technology for officer jobs so that problems in career development, classification, and training, for example, can be broached from a firm empirical knowledge base. Research is presently underway to extend the OS/CODAP technology for enlisted specialties to officer specialties and to develop new measurement techniques where the enlisted technology cannot be directly transferred. Specifically, the objectives are as follows: (a) develop and test job descriptive scales as alternatives to relative time spent, (b) establish the utility of existing task factor scales, (c) develop and test alternate task factor scales where needed, (d) identify appropriate samples for collecting task factor data, and (e) develop CODAP products to display officer data for specific users.

Utilization: Officer occupational surveys will ultimately be developed using validated task factors and job properties singly or in combination. The developed technology will provide the means for establishing an empirical data base for use by Air Force decision makers regarding utilization of officer personnel. Enhanced officer occupational survey methods can be expected to benefit the Air Force in terms of a more effective classification system, more clearly defined educational requirements, and a cost savings in training.

AFHRL Contact: Sherrie Gott
AFHRL/MODS
Brooks AFB TX 78235
Autovon 240-3551
Commercial (512) 536-3551

Title: Development of the Officer Pipeline Management System and Person-Job Match Technology

Description: The Officer Pipeline Management System is designed as a real-time automated officer data management system. Information about unfilled jobs (treated as a job bank) and training school vacancies will be matched with information about soon-to-be-graduated officer candidates, and assignment decisions will be made based upon a person-job match utility score. The vehicle

accomplishing this task is a mathematical model of Air Force managers' decisions about how personnel qualifications and job demands should be jointly considered. The first phase of the project is directed toward application of the procedure in selecting and classifying Officer Training School applicants. The next phase will expand the scope of the procedure to classifying Air Force Academy and Reserve Officers Training Corps graduates.

Additional research supporting this activity is designed to evaluate the educational requirements for officer specialties. It is hypothesized that incumbents can provide suitability ratings for various college transcript summaries. From those ratings, algorithms will be generated to indicate the type of course profiles that may be considered prerequisite for successful job performance.

Utilization: The results of these activities will be incorporated into Officer Recruiting Procedures, Officer Training School Selection Procedures, Air Force Academy and Air Force Reserve Officers Training Corps graduates' initial assignments, and improved management of Officer Training School vacancies.

AFHRL Contact: 1st Lt Lynn M. Scott
AFHRL/MODS
Brooks AFB TX 78235
Autovon 240-2847
Commercial (512) 536-2847

Title: Comprehensive Occupational Data Analysis Programs

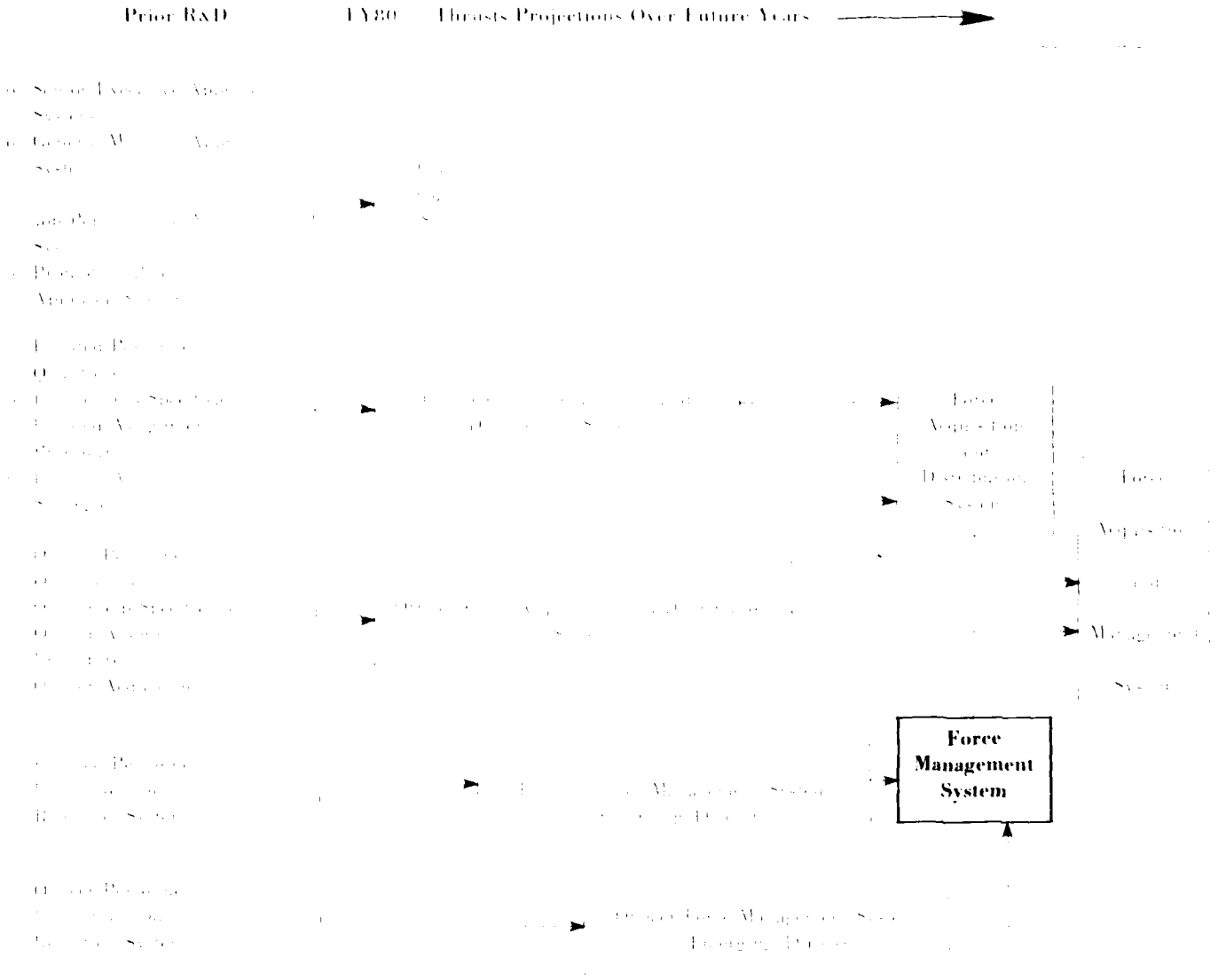
Description: The Comprehensive Occupational Data Analysis Programs (CODAP) is a computerized occupational data analysis software package which inputs and performs calculations on massive quantities of raw data from job surveys. It was developed in response to the need for an efficient and effective method for identifying and classifying jobs in a rapidly changing Air Force. The basic input to this system is information provided by large numbers of job incumbents in the occupational areas being studied. Because the data are selected at the worker-task level, the CODAP system provides a base of information which may be utilized in many ways to address a variety of predefined and sometimes unanticipated management questions. The technical support during the past year has been aimed at continued enhancement of a methodology for restructuring and summarizing these data for higher-level management in increasingly diverse functional areas, and the utility and running efficiency of several major CODAP programs has been increased to meet the needs of the Air Force Occupational Measurement Center at Randolph AFB. A major extension of the CODAP system is planned for the coming year. It will involve the development of a package of profile analysis programs for analyzing and clustering anticipated types of data not amenable to standard CODAP analysis.

Utilization: In addition to its ongoing operational uses in updating and evaluating the Air Force officer and enlisted classification structures and in developing and validating the content of training programs, CODAP is now being employed to develop a scientifically sound basis for realigning entry-level aptitude requirements across Air Force career fields and to address questions about the requirements of jobs, all of which will be integrated into the initial personnel selection process and eventually into the Person-Job Match model. Currently it is also being integrated into the Air Force Specialty Knowledge Test development program as the most effective means of assuring the job-relatedness of test content. The HQ USAF-directed experiment with position-oriented on-the-job training called SPOT (Standardized Position-Oriented Training) is totally dependent on the CODAP data base and software, including recent enhancements to the CODAP system specifically designed for use in the SPOT program. The development of methods for collecting and analyzing the task analysis data which resulted in "The Task Analysis Handbook" will depend heavily on CODAP data and analytic techniques for its implementation in Instructional Systems Development. Although developed by the Air Force, all branches of the United States Department of Defense, as well as the British, Canadian, and Australian Forces, have incorporated CODAP into their operational programs. In the public sector, many state and county governments are using CODAP to validate their traditional testing and selection procedures in accord with Equal Employment Opportunity guidelines, to develop job and performance evaluation procedures, and to improve job classification and training criteria. Educational institutions are using CODAP to modify their vocational education curricula. The transfer of CODAP technology within and outside the Air Force will be intensified with the completion of a series of three CODAP applications manuals—an executive summary designed for management personnel, an inventory developers manual, and an occupational analysts manual.

AFHRL Contact: William J. Phalen
AFHRL/MOMA
Brooks AFB TX 78235
Autovon 240-3222
Commercial (512) 536-3222

Job Inventories

FORCE MANAGEMENT SYSTEM



TECHNICAL ACHIEVEMENTS

Title: Productivity Measurement and Enhancement

Description: Research in this domain has focused on two areas: productivity measurement and productivity enhancement. The purposes of research in the first area are: (a) to review current and past efforts to define/measure productivity, (b) to classify those measures with respect to practicality, cost-effectiveness, and relevance to the Air Force, (c) to systematize the major classes of factors which have been shown to impact on productivity, and (d) to develop a conceptual framework, based on empirical data, that can serve as a guide to future research and evaluation efforts. An extensive field survey of government and civilian agencies with responsibility for research, evaluation, and/or measurement of productivity is currently underway.

In a related effort to develop productivity enhancement techniques, feedback and goal setting techniques were evaluated as motivational treatments in data preparation and data processing sections of a major US corporation. Baseline data were obtained on format effectiveness and error rates on two different shifts. Supervisors were then trained to ensure that subordinates could set specific and quantifiable goals for improving productivity. Treatments were then initiated which involved feedback and goal setting manipulations.

The results included reductions in error rates and increases in format effectiveness. The results were substantially better in the feedback plus the goal setting conditions than in the feedback-only condition. Also, a change from impersonal, comparative feedback to personal, comparative feedback gives greater productivity.

Utilization: Development of a classification scheme for productivity criteria across Air Force jobs will provide researchers and managers with a useful tool for designing and evaluating changes in organizational factors related to productivity. Additionally, the identification of and communication with various agencies involved with productivity research have fostered a positive interaction among those agencies. Technologies for implementing feedback of goal-setting techniques will provide first-line management with a capability for enhancing productivity and job satisfaction that otherwise would not be available.

Benefits: Results from a criterion development study will be used to plan and conduct a comprehensive study of Air Force productivity, increase the generalizability of results from studies on productivity, improve management of Air Force resources, and increase the readiness and effectiveness of Air Force personnel. The motivational techniques used in the second study can be applied to a variety of Air Force work environments without the additional costs that monetary incentive programs typically require.

AFHRL Contact: Charles N. Weaver
AFHRL/MODF
Brooks AFB TX 78235
Autovon 240-3643
Commercial (512) 536-3643

Title: The Integrated Simulation Evaluation Model Prototype Development

Description: The Integrated Simulation Evaluation Model (ISEM) is an effort to develop a large-scale simulation model of the Air Force Manpower and Personnel System, including reserves and civilian employees. The effort attempts to capture in a single model the many interactions and interrelationships among manpower and personnel functions and activities as they operate to meet specified peacetime and wartime scenarios. The ISEM prototype (ISEM-P), which is a smaller-scale version of the total model, simulates the subset of the Air Force enlisted and officer skills, weapons systems, and geographical locations. Currently, the model is undergoing extensive testing and a lengthy sensitivity analysis.

Utilization: The ISEM-P model demonstrates the potential for providing Air Force manpower and personnel decision makers with a tool for policy and decision analysis. The model incorporates a great many of the decision variables into a single, integrated, and unified analytical model that is capable of providing insight to the innumerable interactions that are present in such a complex system as the Air Force and its mission accomplishment. The model was used to examine some 200 different mission type and force structure scenarios for sensitivity to different variable levels and decision policies. The full-scale ISEM will provide manpower and personnel planners with an extremely powerful tool for total force management.

Benefits: The ISEM-P, to a limited extent, and the full-scale, total-force model, to a much greater extent, should improve the decision making capability of Air Force manpower and personnel managers. A model, such as this, which incorporates a total force concept will greatly facilitate peacetime and wartime planning in the total force environment.

AFHRL Contact: Larry T. Looper
AFHRL/MOMD
Brooks AFB TX 78235
Autovon 240-3648
Commercial (512) 536-3648

Title: Retraining and Transferability of Skills

Description: Air Force managers rely heavily on the capability to retrain enlistees from one occupational specialty to another in coping with the continuing problem of personnel shortages and overages in career fields. A comprehensive evaluation of the operational retraining program and of the progress and performance of the 10,000 to 15,000 airmen who change specialties annually is underway. The results of a study of the technical training performance of retrainees was recently published. The academic achievements of retrainees were found to be comparable, and in most schools superior, to those of new recruits with equivalent aptitudes. Analyses further showed that enlistees with high military tenure, career airmen status, and prior experience in a specialty with the same aptitude index were good candidates for retraining. Findings of a second study supported the current policy which permits 10 points of the job aptitude requirement to be waived for retrainees. There were also indications that a more liberal waiver would be defensible in some specialties, if manpower conditions necessitated increasing the number of enlistees qualified for retraining.

Other ongoing and planned retraining research includes identification of the types of reassignment actions which are operating smoothly and those which are generating adjustment problems. Retrained airmen and their supervisors are being surveyed to evaluate the job performance, satisfaction, and attitudes of various retrainee categories including voluntary and involuntary. Skill upgrading, career progression, and reenlistment rates of retrainees are being assessed through comparisons with Air Force averages. A major focus of planned research is transferability of skills and knowledges and the ease of movement between specialties.

Utilization: Managers of the Airman Retraining Program are sponsoring and utilizing the current research which provides an empirical basis for evaluating policy decisions.

Benefits: Improved retrainee selection and assignment procedures can be expected to stimulate participation in the program, favorably impact reenlistment rates, and increase productivity and satisfaction of airmen in second specialties. Assignments which optimize skills transfer will result in dollar savings through lowered attrition rates as well as reductions in training time required for retrained personnel to achieve proficiency in their new occupations.

AFHRL Contact: Mary J. Skinner
AFHRL/MODF
Brooks AFB TX 78235
Autovon 240-3551
Commercial (512) 536-3551

Title: Utilization of Women in the Air Force

Description: During the past decade, the number of women in the Air Force has increased from approximately 12,000 to more than 60,000. To provide Air Force management with information relevant to the optimal utilization of women in nontraditional military roles, research was conducted in three areas. A study of the Aircraft Maintenance Career Field was accomplished with the objective being to evaluate the on-the-job utilization patterns of males and females and identify gender differences in task assignment, job changes over time, and general work experiences. Preliminary results of this study have been briefed and further analyses are in progress. An interim evaluation of the Air Force Female Pilots Program was completed using male/female comparative data collected from Undergraduate Pilot Training, Survival-Resistance Training, Replacement Training Units, and operational squadrons having men and women pilots. No differences between the performance of men and women pilots were identified, and there were many indications that women represent a viable aircrew resource for the Air Force. Finally, an evaluation was accomplished on the introduction of women into Titan II Missile Launch Operations. Comparative male/female data were collected from the various stages of missile crew training and from missile squadrons having men and women. Few differences were found and none appear to substantially limit the role of women in these career fields.

Women In Non-Traditional Military Role

Utilization: Information generated from these studies has been used in making management decisions regarding the utilization of women in the Air Force.

Benefits: Decisions made utilizing this research have allowed an expansion of the role of women in the Air Force resulting in an increase in selection ratios for certain career fields and the optimal utilization of the personnel resources available to the Air Force.

AFHRL Contact: Jeffrey Kantor
AFHRL/MODF
Brooks AFB TX 78235
Autovon 240-3648
Commercial (512) 536-3648

Title: Development of Standardized Position Oriented Training

Description: The on-the-job (OJT) training system currently in use requires that supervisors identify, from the specialty training standard, tasks that should be trained through OJT. The process if done thoroughly can be very time-consuming for individual supervisors. The Standardized Position-Oriented Training (SPOT) system is being developed in response to this need and to improve the quality and tracking of OJT. The research has proposed a model for determining job proficiency requirements, performed field supervisor modification of the job proficiency lists in four specialties, and analyzed the field supervisor job proficiency specifications to determine an empirical model for each of four categories of specialties. These requirements lists are specific for a particular Air Force specialty and have been forwarded to the requirements managers for staffing and field testing by the Major Commands. The final product will be a package to enable automated production of job proficiency lists by job in any Air Force Specialty Code, and it will include a supplement to refine the equation as more widely based data become available.

Utilization: The results of this study will have considerable impact on the Air Force OJT system. Major Commands, the Manpower and Personnel Center, and supervisors will have better control over OJT.

Benefits: The SPOT System will provide a skills experience inventory that is Air Force wide. In addition, the system has potential application to force structure and manning decisions. It will save supervisor manhours in OJT, provide standardized OJT requirements specifications, and improve the quality and tracking of OJT.

AFHRL Contact: Hendrick W. Ruck
AFHRL/MODS
Brooks AFB TX 78235
Autovon 240-3551
Commercial (512) 536-3551

Title: Development of an Air Force Occupational Research Data Bank

Description: Efforts to establish an Air Force Occupational Research Data Bank have resulted in the development of an on-line rapid access retrieval system for different kinds of occupational data. This twofold retrieval system includes summary-descriptive variables about Air Force occupations, occupational survey data for the enlisted occupations, and a research report index system by occupations. The retrieval system provides the capacity to reference research materials through a cross-catalogued key word search; to select, display, and print by specialty and subgroups, variables related to occupational descriptors, prequisites, and enlisted personnel characteristics. It also allows the user to extract various Comprehensive Occupational Data Analysis Programs reports. At present, these prototype systems within the Occupational Research Data Base are operational. Future work will be directed towards the inclusion of officer occupational survey data as well as medical, legal, safety, and manpower requirements data. In addition, longitudinal analysis capabilities will be built into the system.

Utilization: The Occupational Research Data Bank has been designed to support the research thrusts of the Air Force Human Resources Laboratory. The large volume of occupational data contained in the retrieval system provides a centralized location for researchers to obtain quick-response answers for personnel related questions. At present, such questions may take weeks to answer. Cross-comparisons of specialties with respect to their characteristics are feasible and should lead to more effective selection of occupations for special studies.

Benefits: The Occupational Research Data Bank provides rapid access to a centralized source of occupational data. Limited studies with short suspense dates could be accomplished without the need to extract data from longitudinal studies and trend analysis can be performed on a real-time basis to provide a dynamic representation of occupational data.

AFHRL Contact: Hendrick Ruck
AFHRL/MODS
Brooks AFB TX 78235
Autovon 240-3551
Commercial (512) 536-3551

Title: Productivity in Security Police Squadrons

Description: The purpose of this research is to develop a methodology for measuring changes in the productivity of security police squadrons that result from squadron reorganization. Productivity measures include both subjective criteria, such as supervisory ratings, and objective criteria developed in conjunction with job experts from the security police career field. Individual and organizational measures are being collected from bases matched for similarity in all respects except squadron organization. Criterion data were collected prior and subsequent to the reorganization. Policy capturing/specifying techniques will be employed to identify the significant characteristics of effective security police squadrons.

Utilization: The effects of organizational changes implemented at the local level are often difficult to quantify. Techniques developed under this work unit provide a comprehensive and systematic approach to tracking positive and negative changes and for documenting such changes. The results of this research will be used in decisions regarding the organizational structure of security police squadrons in Europe. Additionally, the technologies developed will be applicable for use in security police squadrons throughout the Air Force, as well as, in other Air Force Specialty Codes.

AFHRL Contact: Charles N. Weaver
AFHRL/MODF
Brooks AFB TX 78235
Autovon 240-3613
Commercial (512) 536-3613

Title: Technical Training Graduation/Elimination Rates

Description: Summary reports are prepared quarterly for Air Force enlisted personnel who terminate technical training in each quarter of the fiscal year. These reports are aggregated over the fiscal year. These matrix format type reports contain statistics for all individuals who terminated a particular course in a specific quarter of the fiscal year, such as frequency counts and percentages by reasons for termination of training; average Mechanical, Administrative, General, Electronics and Armed Forces Qualification Test scores for graduates and eliminees; minimum selector Aptitude Index score for entry into the course; and average time in training for graduates and

eliminees. All of these frequency counts and percentages for all individuals are reported by race, sex, race/sex, whether 4-year or 6-year enlistment, academic education level, and mental category.

Utilization: The reports are used by personnel systems managers to track graduation/elimination rates of Air Force enlisted personnel from basic resident technical training courses.

AFHRL Contact: Charles A. Greenway
AFHRL/TSOW
Brooks AFB TX 78235
Autovon 240-3955
Commercial (512) 536-3955

Title: Officer Effectiveness Report System

Description: Officers are normally given Officer Effectiveness Report (OER) evaluations once a year. There are several uses for the evaluations: (a) a tool in determining the best individuals qualified for promotions, (b) a tool for making assignments, (c) a counseling device, and (d) a general personnel

management tool. In addition, these reports aid in the monitoring of the rating trends. The automated OER report system uses the OER records, which have been transcribed to magnetic tape, to produce summary reports on a quarterly and yearly basis for grades of lieutenant through colonel, separately. The reports aid assignment managers, career monitors, personnel managers, and OER monitors.

Utilization: The OER summary reports are used by senior Air Force managers, the promotion secretariat, career monitors, and OER Monitors.

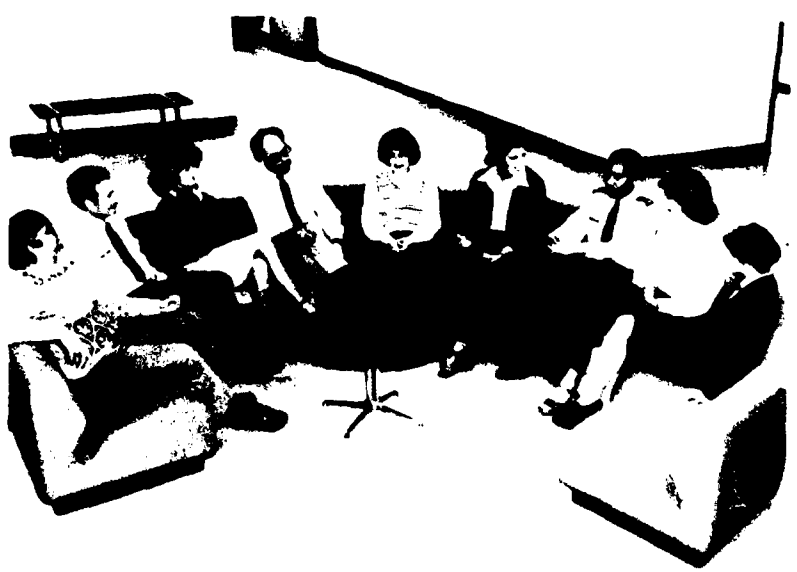
AFHRL Contacts: James L. Friemann
AFHRL/TSOX
Brooks AFB TX 78235
Autovon 240-3955
Commercial (512) 536-3955

Calvin C. Fresne
AFHRL/TSOJ
Brooks AFB TX 78235
Autovon 240-3921
Commercial (512) 536-3921

Title: File Item Data Organizer

Description: The File Item Data Organizer (FIDO) evolved from the need of research efforts involving present and longitudinal sample selection where codes contained in a unique data base had to be identified and interpreted by research scientists with English meanings for coded information, including description of the code, frequency of occurrence, and other descriptive statistics. FIDO also contains an automated inquiry/retrieval system vital for the establishment of data bases for personnel research projects and probe analysis to determine the feasibility of proposed major research efforts involving data bases. FIDO is on-line on the Univac 1108 computer system. It consists of 677 Air Force and Department of Defense defined data elements used in automated Air Force Personnel Data Systems: for example, security classification, grade, Air Force Specialty Code, and major academic field. Present efforts are to provide more accurate and timely data by improving the update procedures now in use and by developing procedures to get this information directly from the Air Force Manual 300-4 data base which the Air Force Data Systems Design Center supplies monthly to the Laboratory by magnetic tape.

Utilization: FIDO directly supports virtually all facets of the Laboratory personnel and manpower research. Many research efforts involve longitudinal studies of specific samples cutting across many different data files and code values over varied time periods. Automated availability of Air Force and Department of Defense defined data elements, as well as other nonstandard data elements, with their data items and meanings across time when combined with heavy usage by programmers/analysts represents a sizeable savings in workhours which would otherwise be spent in researching hundreds of manuals, and/or microfiche by hand in order to find the needed code properly identified for a given historical time period. As implemented, scientists may on retrieval, specify all code values in effect dating back to the



establishment of a given data element or may specify inclusive dates and get only those codes in effect during the interval in question. The data can be displayed on a remote interactive terminal or a hard copy may be requested showing title, data name, definition/explanation, code values, effective dates, and explanation of code values.

AFHRL Contact: John R. Rogers
AFHRL/TSOH
Brooks AFB TX 78235
Autovon 240-3937
Commercial (512) 536-3937

Title: Human Resources Research Data Base

Description: A series of data bases containing information on personnel and training systems has been developed. The data bases are stored on magnetic tape. Software has been implemented to process, organize, and display selected information from a single data base and to consolidate information on a common subgroup from two or more data bases. The data bases include records on all active duty Air Force enlisted and officer personnel at 6-month intervals and on Air Force Reserve and National Guard personnel. Also included are records of graduates from basic military training, technical training, and flying training programs and from the Officer Training School and Reserve Officers Training Corps commissioning programs. Other records reflect separations and losses from active duty. Special purpose longitudinal files derived from these data bases significantly reduce data processing requirements in many personnel and training research studies.

Utilization: The data bases represent a low-cost means of acquiring and maintaining information used in the development and validation of personnel selection and classification instruments, development of assignment procedures, derivation and revalidation of promotion systems, and special purpose analyses to determine the long range impact of specific personnel and training policies.

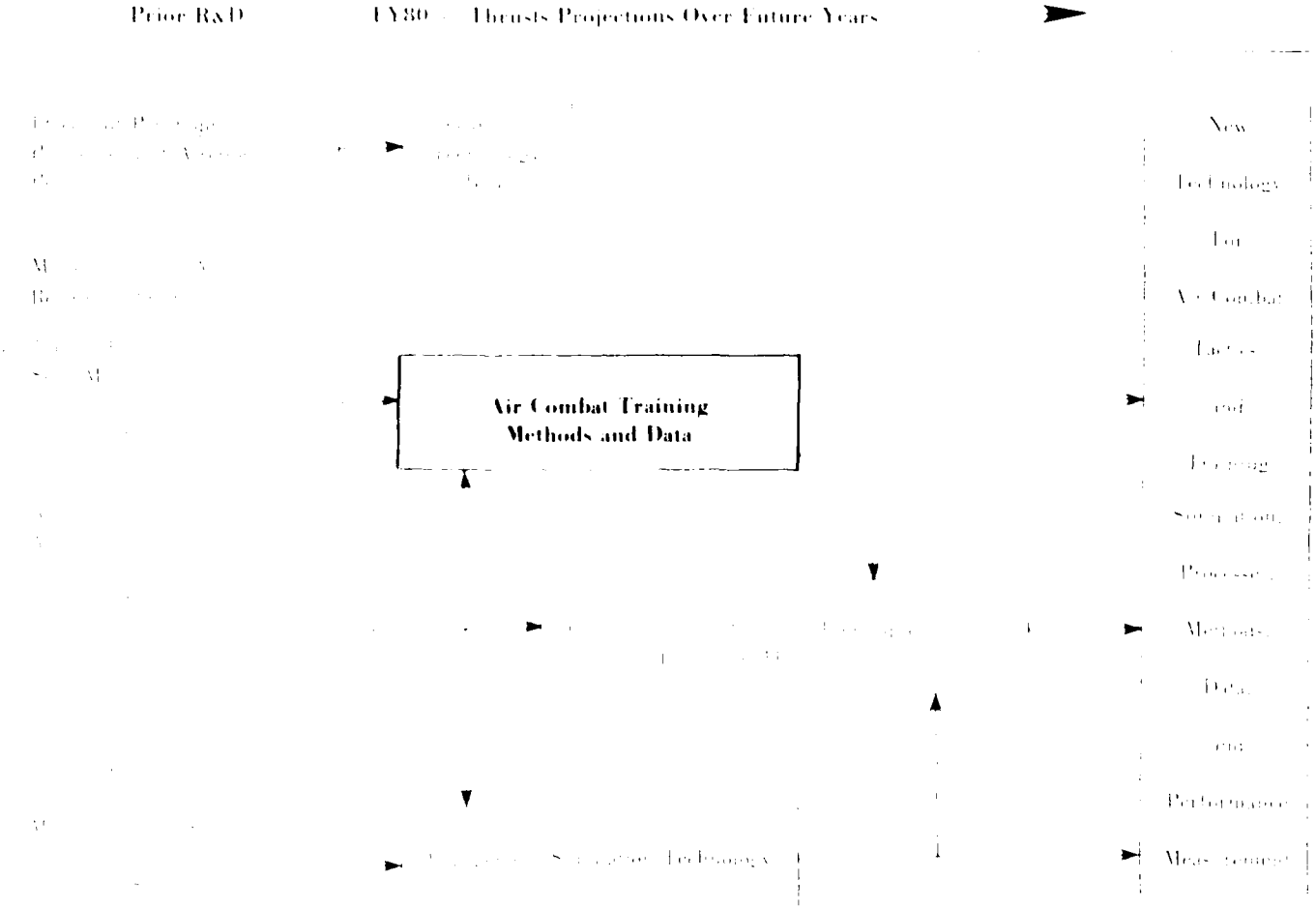
AFHRL Contact: Calvin C. Fresne
AFHRL/TSOJ
Brooks AFB TX 78235
Autovon 240-3921
Commercial (512) 536-3921

There is still one absolute weapon. . . the only weapon capable of operating with complete effectiveness — of dominating every inch of terrain where human beings live and fight, and of doing it under all conditions of light and darkness, heat and cold, desert and forest, mountain and plain. That weapon is man himself.

General Matthew B. Ridgway

AIR COMBAT TACTICS AND TRAINING

AIR COMBAT TRAINING



Title: Adaptive Performance Testing System for Surface Attack Tasks in the Advanced Simulator for Pilot Training

Description: A contract (jointly sponsored by Under Secretary of Defense and the Air Force) was awarded for the development of an adaptive testing model using conventional A-10 weapons delivery tasks for implementation on the Advanced Simulator for Pilot Training (ASPT). The effort required the selection of flight test tasks, definition of the performance measures for those tasks, definition of an adaptive controller model, development of a functional specification for software changes on the ASPT, and an empirical development and test plan. A 20-task flight test syllabus was developed which included high and low angle bomb delivery and high and low angle strafe deliveries to be tested under five windage conditions (none, head, tail, quarter, and cross). Candidate performance measures for each task were specified. The adaptive controller logic employs non-linear programming for testing on a difficulty dimension and a diagnostic dimension. The empirical development plan outlines a 27-month effort to fully implement and test the adaptive model.

Utilization: Enhanced capability to measure performance proficiency and diagnose regions of marginal performance could impact training system design and sortie allocation.

Benefits: Increased efficiency in performance assessment and diagnosis should lead to an increase in the overall quality of performance which in turn effects mission readiness.

AFHRL Contact: Elizabeth Martin
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

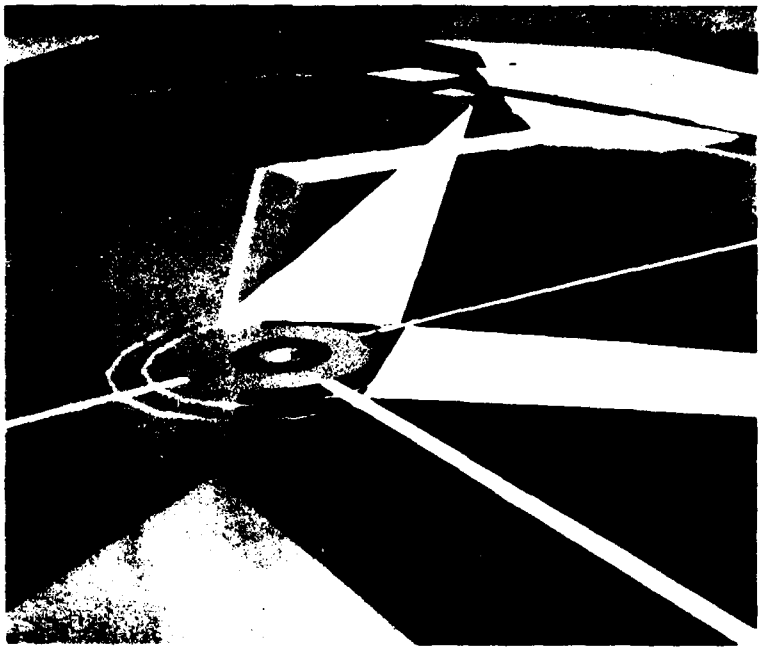
Title: Simulator for Air-to-Air Combat Target Enhancement Study

Description: The study involved an evaluation of out-of-the-cockpit visual cues associated with the target aircraft by students flying the Simulator for Air-to-Air Combat (SAAC).

Utilization: It was found that the essential visual cues are available and additional cues are not necessary. Existing cues should be upgraded. Target definition should be improved at longer ranges, and a third target image should be added to eliminate using the sun image as a wingman. These modifications are underway.

Benefits: A determination of the most important visual cues will enhance the fidelity of the SAAC and provide more realistic training. The main benefit will be the improvement of simulator training for air-to-air combat training.

AFHRL Contact: W. Nelson
AFHRL/OTGO
Luke AFB AZ 85309
Autovon 853-7058
Commercial (602) 935-7058



Simulated Visual Scene Used For Bomb Delivery and Strafe

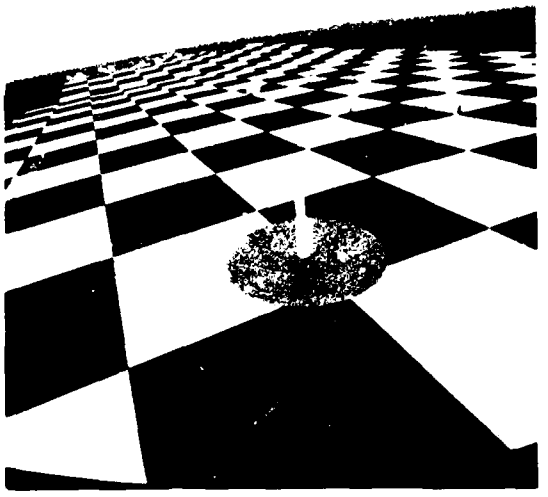
Title: Visual Cue Requirements for Terrain Flight Simulation

Description: The lack of adequate visual scene detail is often considered to be a limiting factor in the use of computer-generated imagery for terrain flight. Terrain flight is an important means of survival in the face of the enemy and includes low level, contour, and nap-of-the-earth (NOE) flight at successively closer approaches to the ground. In such close proximity to the ground, a great deal of visual detail is available to pilots, far more detail than it is currently feasible to simulate with computer image generation (CIG) systems. This research study developed a special visual environment which allowed the CIG visual cues to be maximized within a limited area. During the study, the types of visual cues available to the pilots were varied in order to identify, by pilot performance measurement, those cues which are most important for terrain flight simulation.

Utilization: This study is the first in a series of efforts to develop suitable visual cues for training terrain flying. This critical flight skill is quite hazardous to perform in actual aircraft, thus making flight simulation a particularly important alternative form of flying training. This particular study should be especially useful because it seeks to implement simulation training using CIG hardware that is already operating. Thus, it will not require the development of new hardware techniques before it can be implemented in other flight simulators using CIG visual displays.

Benefits: This study has demonstrated that it is feasible for pilots to fly simulated visual scenes at very low altitudes (50 feet above ground level) while following hill contours and maneuvering around vertical objects. While this is possible using very limited scenes in current visual flight simulators, it should be possible to display much more complex scenes with future CIG visual systems which will have increased edge capacity and texture pattern generators. This study has demonstrated the utility and necessity for both types of increased CIG capability, and has effectively illustrated the potential for training many aspects of low-level flight in visual flight simulators.

AFHRL Contact: Maj George Buckland
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



AS[illegible] CIG Low Level Visual

Title: Effects of G-Suit, G-Seat, and Helmet-Loader G Cueing on Pilot Simulator Performance

Description: This study investigated the effects of the G-suit, G-seat, and helmet-loader force-cueing systems on pilot simulator performance in sustained G-loading maneuvers. Eleven experienced fighter pilots were required to fly a standard G-profile consisting of four G-loading maneuvers in the Advanced Simulator for Pilot Training (ASPT) in the F-16 configuration. Each pilot flew the G-profile in each of eight force-cueing conditions. Multiple comparisons were conducted on the mean and variability of G sustained in each maneuver for the eight force-cueing conditions. Comparison of each device to the no cueing condition indicated no reliable effects for any of the three cueing systems in the sustained 2G maneuver. At moderate to high G-forces (4G to 6G), the G-suit reduced variability in G by 25% to 35% but resulted in consistent overestimation of the actual G-load sustained. Activation of the helmet-loader system resulted in a 15% to 22% reduction in G variability and in the highest accuracy of G-loading estimation. The G-seat system had no reliable effects on pilot performance. Combined activation of the force-cueing systems did not affect pilot performance beyond that achieved from individual cueing system effects.

Utilization: The present results indicate that the G suit and helmet-loader force-cueing systems are effective in

ASPT F-16 Cockpit Module

providing force cues to the pilot. However, reduction in G-suit pressurization below that used in the present study is required. The G-seat system proved to be an ineffective device for providing sustained G-loading information to the pilot. Combining cueing systems does not provide enhanced force-cueing capability for sustained G maneuvers.

Benefits: The results of this research will be utilized in defining requirements needed to design valid force cueing devices for flight simulation of realistic combat maneuvers.

AFHRL Contact: Alfred Lee
AFHRL/OTC
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Comparison of Color Versus Black-and-White Visual Display as Indicated by Bombing Performance in the 2B35 TA-4J Flight Simulator

Description: With the proliferation of color computer-generated imagery (CGI) systems, there has also been a trend toward the use of color systems in flight simulation. The research in this area, the need for color, has been inconclusive. Some studies show enhancement resulting from the use of color in some specific instances, while others show none at all. It seems clear that insufficient information is available at present to fully accept or reject the use of color in simulation. The problem in brief, is to gain sufficient information on the subject of color versus black and white in simulation to determine the utility of color presentation. Toward this end, a study was developed to compare bombing scores in both color and black-and-white presentations. The General Electric 2B35 light-valve projected color system was used in this study. This simulator is used by the Navy for air-to-ground weapons delivery training in the TA-4J aircraft. The system consists basically of three CGI images projected on three screens surrounding the cockpit. This presentation allows for 210 horizontal and 60 vertical viewing. The pilot flies a designated bombing course in real time, releasing his bombs on a bombing circle. The associated computer is programmed to score the important release parameters as well as distance and direction of hit from the target. Ten highly skilled and experienced instructor pilots served as subjects in this study. Five of the pilots flew repeated bombing runs in which color was presented for the first half of the mission and black and white during the second half. The other five pilots reversed this procedure, with black and white

presented first and then color. The black and white and the color were carefully controlled so as to be presented at the same luminous intensity. Analysis of these data showed that, when bombing scores are used as the criterion, there was no statistically significant difference between color and black-and-white performance. Although user acceptance of color systems may be a very important factor, at present, there is no compelling evidence to support the added expense of color in flight simulation. A great deal more research is required, particularly in the area of transfer of training to the operational setting. The present study does not support the need for color in flight simulation.

Utilization: Since this is the first study to use the same CGI presentation both in color and in black and white in a real-time performance task of weapons delivery, it points the way toward direct evaluation of this area in more refined approaches.

Benefits: The potential benefit of this study and follow-on studies with more refined measurements will allow better determinations with respect to the cost benefits of including color in complex flight simulation.

AFHRL Contact: Robert S. Kellogg &
Robert R. Woodruff
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Simulator for Air-to-Air Combat Visual Dysfunction Study

Description: The psychophysiological aftereffects of flying the Simulator for Air-to-Air Combat (SAAC) were evaluated and the physical or mental dysfunctions brought on by such training were determined.

Utilization: It was found that several instructional strategies and media caused varying degrees of psychophysiological disturbances, such as room spinning around after lying down at night, and flashback appearances of checkerboard-like squares before the eyes with sudden awakening at night. The results of the study were used to improve instructional methods, to brief students on visual impact of the SAAC, and continue efforts to describe the cause.

Benefits: Such dysfunctions, if occurring in actual flight, are of major safety importance. Documentation of this data could affect policy both in the SAAC and other visual simulators. This should help to ameliorate aftereffects that include mental and perceptual disorientation and should improve SAAC training.

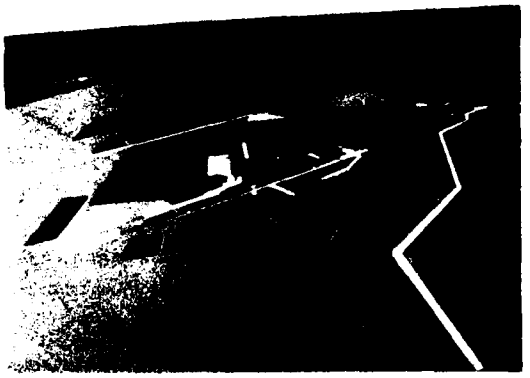
AFHRL Contact: W. Nelson
AFHRL/OTGO
Luke AFB AZ 85309
Autovon 853-7058
Commercial (602) 935-7058

Title: A-10 Combat Scenario Development and Evaluation: Low Altitude Simulation Training

Description: An effort is underway to examine the feasibility of providing supplemental Basic Attack Maneuvers and Low Level Navigation training using the Advanced Simulator for Pilot Training A-10 aircraft configuration. Specifically, the research will assess the effect such training has on student airborne performances.

Utilization: The effort will help determine the utility of full mission simulators in training low altitude tasks. The result will be directly applicable to A-10 training syllabus development.

AFHRL Contact: Byron J. Pierce
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



ASPT CIG Hill Air Force Base Environment

Title: Combined Effects of Weather Elements on Pilot Performance; F-16 ILS Training Study

Description: The high fidelity ground-based simulator provides an enhanced capability for training instrumented landing system approaches under simulated adverse weather conditions. A need exists to determine the effects various weather elements have on student performances in the simulator. The objective of this effort is two-fold: (a) to determine the effect of wind velocity, wind direction and visibility on pilot performance and (b) to apply this information to the development of an effective simulator scenario for training landing approaches using the instrumented landing system under adverse conditions.

Utilization: The results of this effort will apply to issues concerning the development of simulator training scenarios for F-16 pilots.

AFHRL Contact: Byron J. Pierce
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Human Operator Control Strategy Model

Description: The objectives of this effort are (a) to identify human operator characteristics that should be incorporated in a model of control strategy learning in aircraft pilots, (b) to develop a model based on theory-of-control strategy development and learning, and (c) to conduct extensive validation tests of the model. The long range goal of this research is to provide a measurement system that can quantify the effect on skill development of various flight training procedures.

Utilization: This research will (a) provide useful information for the design of all training devices, (b) provide a means of specifying cost-effective training methods, and (c) provide a means to predict with known confidence limits a pilot trainee's control performance under various flight conditions.

AFHRL Contact: T.M. Longridge
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Air Combat Maneuvering Performance Measurement System Development and Training Effectiveness Evaluation

Description: This system is being developed to quantify tactically meaningful offensive and defensive maneuvering performance. The system will be compatible with the Simulator for Air-to-Air Combat and Air Combat Maneuvering Range/Instrumentation (ACMR/I). Transfer-of-training studies are projected when the system becomes operational.

Utilization: The quantification of individual/unit combat readiness in the air-to-air task/Tactical Air Command training and operational units will provide for better measures of pilot and unit readiness.

AFHRL Contact: Orie V. Stafford, Jr.
AFHRL/OTGO
Luke AFB AZ 85309
Autovon 853-7058
Commercial (602) 935-7058

Title: Automated Performance Measurement System C-5 Aircraft

Description: Development is continuing of a prototype, automated performance measurement system for an operational flight training simulator. The system for the C-5A aircraft is to be shipped to Altus AFB in April 1981, and beginning in September 1981, a two-year evaluation of the system will be initiated. Following completion of the simulator measurement system, a companion airborne measurement system will be developed and integrated with the simulator system. The combined system will allow for the comparison of aircrew performances measured both in the simulator and in the aircraft, comparisons which should greatly facilitate answering critical transfer-of-training questions concerning aircrew training device effectiveness.

Utilization: The C-5 Performance Measurement System will provide Military Airlift Command with the means for quantitatively assessing the training effectiveness of C-5A aircrew training. As a prototype, the system will aid in the functional specification of measurement systems for future aircraft. The system should be of special interest to Air Training Command in identifying measurement requirements for tanker/transport/bomber training.

AFHRL Contact: Ronald Hughes
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Air Combat Maneuvering Diagnostic Methodology Performance Measurement

Description: An iterative analysis of data collected on the Good Stick Index is being made using emphasis on the Tactical Air Space (TAC SPACE) measurement structure concept, in order to determine the utility of that concept in providing real-time presentation performance data. The Good Stick Index is a measure of the training Tactical Air Command and Aerospace Defense Command pilots receive during Air Combat Maneuvering (ACM) training programs at the Vought Corporation Simulation Facility.

Utilization. This effort should impact the basic technology concerning performance measurement applications in an ACM simulation environment. The results may also lead to use of improved ACM measures both on the simulator and the ACM Range/Instrumentation. The development of a functional specification for a performance measurement system, which can be implemented on the Simulator for Air-to-Air Combat (SAAC), will also describe for the SAAC programming staff the functional requirements for software to implement the developed performance measurement methodology, with the information presented to the Instructor Pilot in the recommended formats. It should be possible later to apply this index to range performance in actual aircraft.

AFHRL Contact: W. Nelson
AFHRL/OTGO
Luke AFB AZ 85309
Autovon 853-7058
Commercial (602) 935-7058

Title: Air Force Skills Maintenance and Reacquisition Training Research Program (Project SMART)

Description: Project SMART (Skills Maintenance and Reacquisition Training) has been designed to develop and validate comprehensive, quantitative, objective procedures which will permit the Air Force to manage an

individualized flying training program to provide acceptable aircrew mission readiness at minimum cost. This objective will be achieved through the orderly accomplishment of the following research phases: (a) preliminary evaluation of Project SMART methodology, (b) identification and definition of critical flying skills and the development and test of objective procedures for measuring them, (c) measurement of the retention of mission readiness skills as a function of duration of periods of no flying, and (d) evaluation of the effectiveness of alternative programs designed to maintain and foster rapid reacquisition of these critical skills. Project SMART was initiated in 1978 with participation by the Strategic Air Command and the Tactical Air Command. This research was sponsored by the Air Force Directorate of Operations, Plans, and Readiness. Since then the Tactical Air Command program has completed Phase I and a portion of Phase II research. This work has focused on air-to-surface weapon delivery and air-to-air combat tasks and skills. Research is in progress to develop a comprehensive set of measures and critical flying skills that can be made in flight, in simulator, and using other ground-based skill measurement procedures. The F-4, F-15 and A-10 systems are being studied in the development of these measures. In the Strategic Air Command research program Phase I research has focused on the B-52 low altitude bomb run employing the major weapon delivery modes. Analysis of radar navigation weapon delivery accuracy has been initiated, as well as a study describing the performance of the Electronic Warfare Officer. Measures of aircraft commander and copilot performance are being developed through analysis of the approach and landing and in-flight refueling tasks. The skill measurement efforts with the B-52 crewmen have employed existing in-flight and simulator training performance data. As the crew performance/skill measures are developed and validated, they will be applied in training programs using the new B-52/UC-135 Weapon System Trainer and the companion trainer aircraft as these systems are implemented within the Strategic Air Command flying training program.

Utilization: Skill measurement procedures developed by Project SMART will be used by Air Force training managers to assess the effectiveness of current and upcoming training methods and equipment and to guide in the fine tuning of future training programs to maximize the gain in Air Force combat capability per unit of training resources used.

AFHRL Contact: Edward E. Eddowes
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Cognitive Aspects of Energy Management

Description: This research is investigating the utilization of effective energy management strategies to control aircraft. A non-real-time vehicle control task will be presented to subjects via computerized presentation. This study is thus investigating experimental and strategic factors influencing pilots' cognitive abilities.

Utilization: Results of the research effort will be used to develop procedures for employing non-real-time tasks as pretraining aids for difficult and dangerous flying tasks.

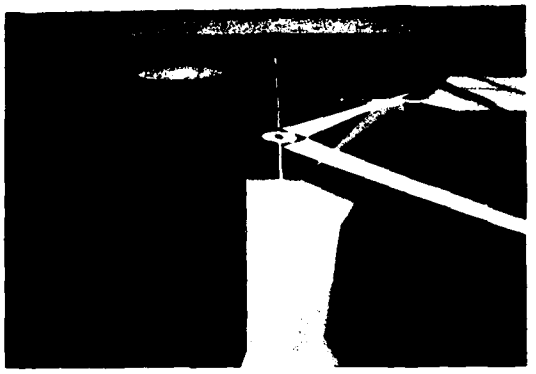
AFHRL Contact: Joseph DeMaio
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Acquisition of Weapons Delivery Skill

Description: The acquisition of skill in the operation of weapons delivery systems in advanced fighter aircraft is of continual interest among training management personnel, weapon systems designers, and operations personnel in Air Force tactical units. The purpose of this research effort is to examine variables affecting the acquisition of weapons delivery skill such as pilot experience level, duration of non-flying status and weapons systems characteristics (e.g., manual versus computer-assisted). The results of this effort will provide for the reliable projection of weapons skill degradation in the pilot population as well as indicate potential modifications to weapons systems operational requirements to facilitate acquisition and retention.

Utilization: This effort will provide information necessary for the maintenance of air combat skill in Air Force tactical units by providing rates of skill degradation and skill acquisition of advanced weapons delivery systems for specific pilot populations. An additional benefit will be the identification of simulator training technologies for the maintenance and acquisition of weapons delivery skill.

AFHRL Contact: Alfred Lee
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



ASPT CIG Weapons Delivery Range

Title: Force Cue Requirements for Air-to-Surface Weapons Delivery Simulation

Description: A transfer of training study was conducted on the Advanced Simulator for Pilot Training in order to evaluate the effects of the following methods of simulator force cueing upon subsequent transfer to the aircraft during A-10 conversion training and A-10 air-to-surface weapons delivery training: (a) six-degrees-of-freedom platform motion, (b) G-seat and G-suit, (c) G-suit alone, and (d) no force cueing. The G-seat was not evaluated separately. A total of 49 B-course students from seven A-10 classes were used as subjects. Following graduation from Undergraduate Pilot Training, these students attended T-38 fighter lead-in training prior to beginning A-10 Combat Crew Training. The subjects flew conversion and air-to-surface weapons delivery maneuvers in the A-10 simulator (where automated performance measures and weapons delivery scores were recorded) and in the A-10 aircraft (where instructor pilot ratings of flying performance and gunnery range scores served as criteria). Analysis of the data is currently being conducted to determine the relationship between flying skills exhibited in the A-10 simulator and those shown in the A-10 aircraft.

Utilization: This research will produce data that will have direct impact upon the definition of A-10 simulator requirements.

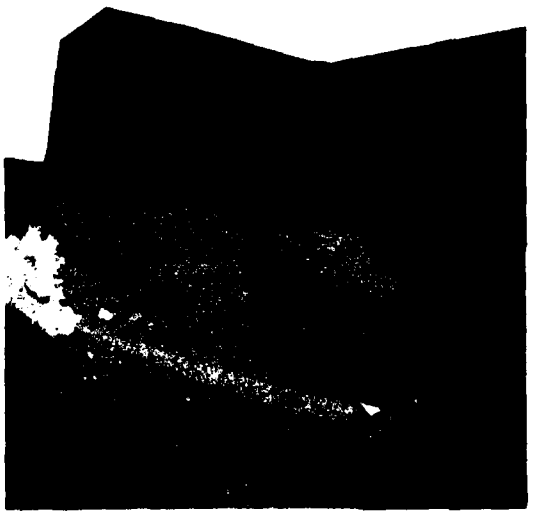
AFHRL Contact: Rebecca B. Brooks
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Vertical Cueing for Low Level Flight

Description: A series of parametric studies designed to investigate the effects of vertical cues on the ability to conduct various low-level flight tasks are being conducted on the Advanced Simulator for Pilot Training. The independent variables include cue height, shade, density, shape, task altitude, airspeed, and pilot experience. The studies are being conducted in the F-16 configuration of the simulator using pilots who are transitioning to the F-16 aircraft.

Utilization: The results of these studies will impact the design of the visual scenes developed to support training research in other flight test applications. The results will also provide data regarding the role of vertical development in the perception of height, depth, movement in depth, and surface orientation. It is anticipated that the information regarding visual perception can be used to design a simulator environment to support part-task training of low level flight. The data could also be used by simulator system designers to set minimum specifications for visual displays.

AFHRL Contact: Elizabeth Martin
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



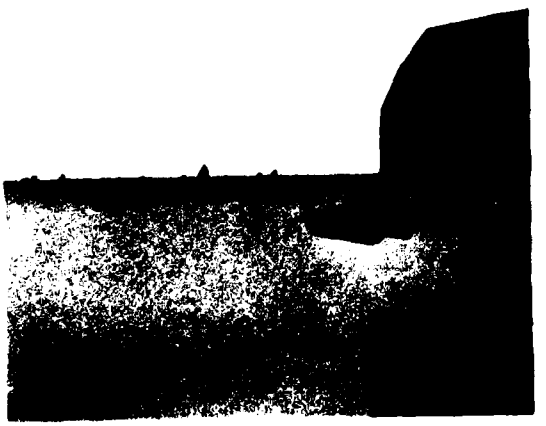
ASPT CIG Vertical Cues for Low Level Flight

Title: Scenario Requirements for Simulated Tactical Ground Attack Training

Description: The objective of this research is to define, develop, and evaluate those aspects of the F-16 tactical ground attack mission that can be effectively simulated in the Advanced Simulator for Pilot Training. The technical approach is to develop alternative scenarios in which critical training factors and mission elements can be manipulated in a systematic fashion. Experienced tactical fighter/attack pilots will be used as subjects in a series of experiments using alternative scenario configurations. Initial research will concentrate on the part-task scenarios of visual target area penetration, attack, and egress. Those aspects of mission planning, weapon system operation, and tactics selection under the pilot's control will be studied to identify the skills which can be enhanced by simulator training in high threat scenarios.

Utilization: The results of this research should impact simulator design and procurement decisions for future fighter/attack aircraft simulators. The results should also impact the development and evaluation of tactics by providing a test bed for empirical testing as an adjunct to theoretical model manipulations and special exercises. Effective simulator scenarios should provide a mechanism for enhancing pilot skills for those aspects of tactical missions which are normally only experienced in actual combat. A dramatic increase in mission readiness is possible. Additionally, the effect of enhanced pilot skill can be evaluated relative to existing models of force effectiveness.

AFHRL Contact: Elizabeth Martin
AFHRL/OTG
Williams AFB, AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



ASPT CIG Ground Attack Scenario

Title: Visual Acquisition of (ACM) Targets in the Simulator for Air-to-Air Combat

Description: This effort evaluates the limitations in the Simulator for Air-to-Air Combat visual systems that inhibit Air Combat Maneuvering training. It will document the capabilities and provide assessment of system limitations.

Utilization: Potential improved target imagery for simulator Air Combat Maneuvering Training.

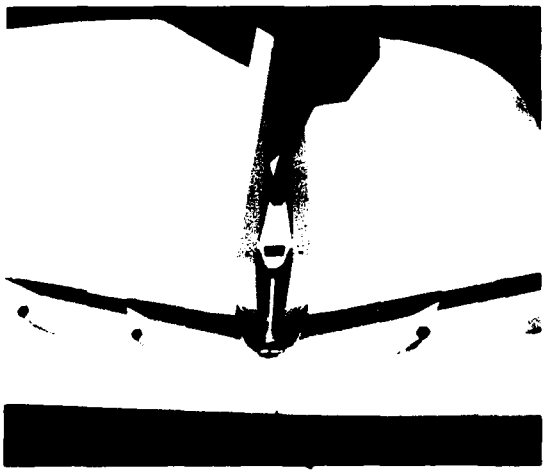
AFHRL Contact: W. Nelson
AFHRL/OTGO
Luke AFB AZ 85309
Autovon 853-6561
Commercial (602) 935-6561

Title: Aerial Refueling Display Cue Study

Description: The objective of this research program is to define the visual cue requirements for a C-5/C-141 Aerial Refueling Part-Task Trainer. Specifically, the study is designed to address the issues of field of view (FOV) and resolution. Preliminary recommendations have been made based on the results of ongoing aerial refueling training in Strategic Air Command and Military Airlift Command. Further research will extend the study into the area of transfer-of-training effectiveness.

Utilization: The research results will have a direct effect on the design and procurement of the C-5/C-141 Aerial Refueling Part-Task Trainer. The procurement of an effective refueling trainer will have a substantial impact on the costs of training and of requalifying pilots in aerial refueling. By removing the need to conduct initial training exercises in the air, the potential flight safety risks, inherent in this task, will be significantly reduced. In addition, the life of C-5/C-141 airframes will be extended and the need for maintenance reduced.

AFHRL Contact: I.G. Lidderdale
(UK Exchange Scientist)
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



ASPT Aerial Refueling Display

Title: Pilot Memory Structure

Description: Basic psychological research tasks employing response latency measures are being utilized to make inferences regarding the structure/organization of pilot's memory for critical flight information. The pilots make classificatory decisions regarding flight related terms. The time required to make these classifications will be utilized to make inferences regarding the relation of the terms in the pilot's memory and the structure of that cognitive memory.

Utilization: The results of this research effort will impact the assessment of pilot readiness. This research will also impact the evaluation of future training aids and of cockpit designs.

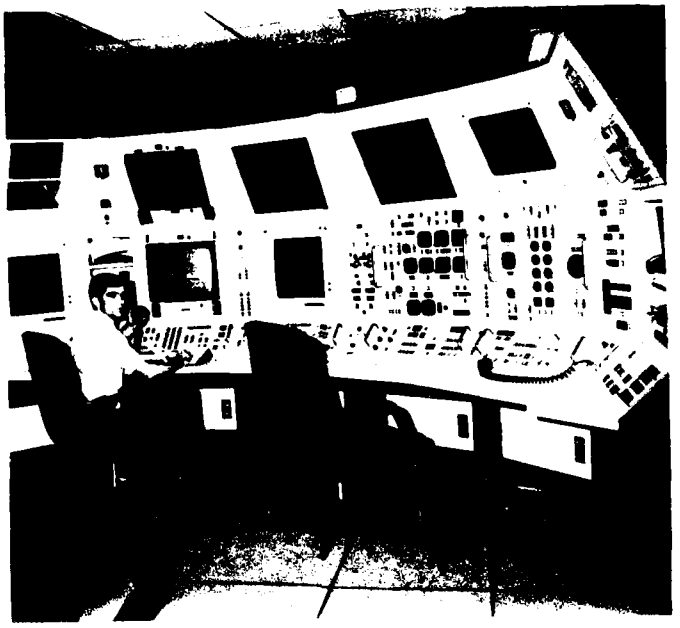
AFHRL Contact: Joseph DeMaio
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Instructor/Operator Station Design and Instructional Features

Description: In the area of instructor/operator station (IOS) design, several efforts were completed. Advanced techniques were developed for characterizing important aspects of tactical performance in flight simulators for display at the IOS. The work included development and test of methods for quantifying the importance or value assigned by students to various performance criteria and to the acquisition of various vantage points in the maneuvering envelope. Also, methods were devised for optimizing the use of computer graphics for providing three-dimensional views of aircraft maneuvering. Finally, methods were developed and applied for synthesizing IOS displays. This synthesis sought to minimize the need to scan many sources of information by maximizing the information content of a finite display area and by capitalizing on user information processing characteristics and unique abilities. A joint research study was conducted on the Visual Technology Research Simulator by the Air Force Human Resources Laboratory and Naval Training Equipment Center. The study addressed the instructional control over student errors during the acquisition of a carrier landing task. This study represents the first time that the freeze feature has been systematically investigated for any perceived instructional value in the simulator. The results are currently being analyzed. The data have importance for non-carrier approaches as well, including Instrument Landing System approaches, weapons delivery, etc.

Utilization: Work in the analysis of IOS design requirements will impact the design of future IOSs. The results of these studies are of immediate interest and value to the Deputy for Simulator Procurement. Studies such as that on the instructional use of the freeze feature will benefit users of simulators, such as the Air Training Command and the Tactical Air Command, in making optimum use of instructional support features currently found on existing simulators.

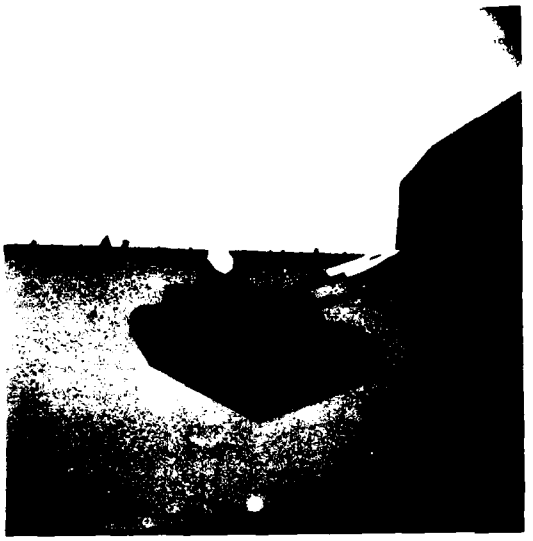
AFHRL Contact: Ronald Hughes
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



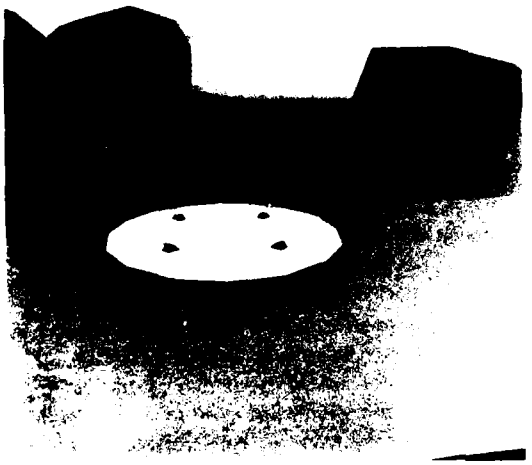
Instructor/Operator Console for ASPT

Title: Tactics Training Research

Description: The development of the high-threat ground attack environment continued, with expansion to the Advanced Simulator for Pilot Training (ASPT) F-16 aircraft configuration as well as for the A-10 aircraft configuration. Company-size target arrays depicting armor-type targets were implemented for the A-10 scenario, as were representative air defense threats found at the level of the motorized Soviet rifle division. Threat fidelity (from a modeling standpoint) has emerged as a significant area of concern in tactical training simulation. The impacts of computational constraints on high-fidelity real-time threat simulation must be determined. From the standpoint of visual system requirements, the impact of poor resolution on target detection performance was overcome in part by varying the critical dimensions of targets as a function of range. Similar efforts are being evaluated for depicting the critical visual cues associated with the launch and flight of air defense threats. These efforts have indicated that design tradeoffs for resolution may be possible under certain tactical simulation task conditions. Several individual studies have dealt with the requirement for low-level visual cues. The inverted "cone" has been used to effectively provide for varying densities of low-level visual cues. While some baseline of terrain crashes must still be attributed to inadequate visual cues, studies have shown that the majority of crashes must be attributed to the high level of task loading associated with operating in a high-threat tactical environment. A study was also run to determine the effects of threat suppression on A-10 survivability and mission effectiveness. The threat suppression study has important implications for predictions of A-10 survivability and mission effectiveness in high-threat close air support environments. Work is continuing on the use of moving models to display multiple air defense threats and for the efficient display of moving targets utilizing a finite number of moving models. In the area of air-to-air combat maneuvering, efforts were initiated to make use of non-real-time engagement simulation models, such as TAC BRAWLER, for conducting sensitivity analyses of visual system design variables and their impact upon simulated tactical performance capabilities and outcomes. A chief use of models such as TAC BRAWLER will be to assist in identifying behavioral issues in air-to-air combat, issues which will have high priority for use of ASPT/F-16 configuration, once an air-to-air capability is achieved. Future plans for the use of the ASPT/F-16 cockpit assume potential involvement in the Advanced Fighter Technology Program.



ASPT CIG Ground Threat Displays



Utilization: The work over the past year has demonstrated significant advances in the extent to which a flight simulator may be used for tactical aircrew training, especially in the air-to-ground attack role. These data have great implications for the Tactical Air Command. Individual studies which have dealt with overcoming the problems of poor visual system resolution (e.g., in the areas of target detection and low level cues) will impact future simulator requirements. The breadth of tactical tasks now possible in the A-10 and F-16 configurations of the Advanced Simulator for Pilot Training provides for an ideal test bed where issues/technology, etc. affecting tactical performance can be evaluated under controlled conditions in the simulator.

AFHRL Contact: Ronald Hughes
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Operational Test and Evaluation Handbook for Aircrew Training Devices

Description: The Air Force plans extensive simulator procurements in order to maintain operational readiness and reduce training costs. These simulators will be employed across the entire flight training spectrum, beginning with Undergraduate Pilot Training, continuing through Combat Crew Training; and, culminating in the maintenance of proficiency in aircrew skills. The critical requirement is that these simulators provide a training medium that enhances aircrew quality while using fewer resources than would be consumed by the aircraft. Since significant Department of Defense investments depend on the capabilities of these simulators, their training effectiveness must be thoroughly and accurately evaluated. Although the Air Force plans to conduct a series of tests and evaluations on these devices, the methodologies and techniques by which these are to be accomplished has not been determined. What can be stated with certainty is that a multidisciplinary approach will be required. At a minimum, thorough tests and evaluations will include considerations of training capabilities and transfer, media utilization, human engineering, device reliability and maintainability, and life-cycle costs. Knowledge from the fields of psychology, education, engineering and economics must be combined to provide a cohesive approach. Consequently, a handbook is required that will do the following:

1. Determine appropriate methodologies that can be utilized as standards for assessing simulator training effectiveness. The major elements of this effort will include (a) application of alternate definitions of training effectiveness suitable for various systems, (b) selection of measures and techniques that will validly and reliably evaluate levels of individual task performance for both student and instructor/operator personnel (items to be considered include appropriate statistical analyses, sample sizes, sample representativeness, and training criteria selection), (c) investigation of student/instructor/operator/training manager attitudes and their impact on simulator acceptance, utilization, and confidence in the training program, (d) investigation of the relationship between system availability and reliability and the capability to maintain the intended training program.

2. Determine appropriate techniques to evaluate system control features such as the instructor/operator console;

adaptive training provisions; system operability; and special system training capabilities such as freeze, reset, automated playback, and prerecorded demonstrations.

3. Determine the appropriate composition of the Operational Test and Evaluation Team in terms of disciplinary skills and experience.

4. Determine the resources necessary to conduct Operational Tests and Evaluations in terms of personnel, hardware, and software.

Utilization: The research results will (a) provide Air Force leadership with direction in making sound decisions in allocating huge expenditures on aircrew simulators, and (b) provide the operational Air Force units proper methodology in the planning and conduct of aircrew simulator test and evaluation programs for a variety of systems.

AFHRL Contact: T. H. Gray
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: E-3A Mission Simulator

Description: An effort is underway to assess the features and capability of the E-3A Mission Simulator, including its instructional type features and capability of simulation support function. The effort will also assess the human factors engineering of the support capsule and its training capability.

Utilization: The data from this effort will be used to support mission crew training and qualification, as well as continuation and upgrade training, by identifying needed improvements in the Mission Simulator and/or its utilization.

AFHRL Contact: W. Nelson
AFHRL/OTGO
Luke AFB AZ 85309
Autovon 853-7058
Commercial (602) 935-7058

Title: Companion Trainer Aircraft

Description: Strategic Air Command has proposed the operational use of a Companion Trainer Aircraft (CTA) to augment continuation training for crews B-52 G/H aircraft. The CTA will be a low-cost commercial business jet, configured to provide skill maintenance in the areas of (a) low-level navigation, (b) low-level bombing, (c) air refueling rendezvous, (d) instrument procedures, (e) missile launch, and (f) electronic warfare procedures. The CTA will be used to train all crew members except the gunner. The CTA Project Office at the Aeronautical Systems Division, Wright-Patterson AFB, asked Air Force Human Resources Laboratory to assist in defining the training and human factors considerations appropriate for the CTA. The recommendations from this study are to be used as an aid in evaluating contractor-proposed CTA configurations.

Utilization: The Air Force Human Resources Laboratory is serving as an integrator of training and human factors issues through extensive coordination with other interested organizations.. Early AFHRL involvement in the CTA project provided an opportunity to structure CTA configuration criteria on the basis of training and human factors requirements. So far, the Air Force Human Resources Laboratory has provided the CTA Project Office with recommendations that will guide them in evaluating contract proposals. These recommendations define minimum training requirements and should highlight any contractor proposed variations which would negatively impact CTA skill maintenance potential.

AFHRL Contact: Milton Wood
AFHRL/OT
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Assessment of Workload and Prediction of Performance by Combined Psychophysiological and Behavioral Techniques

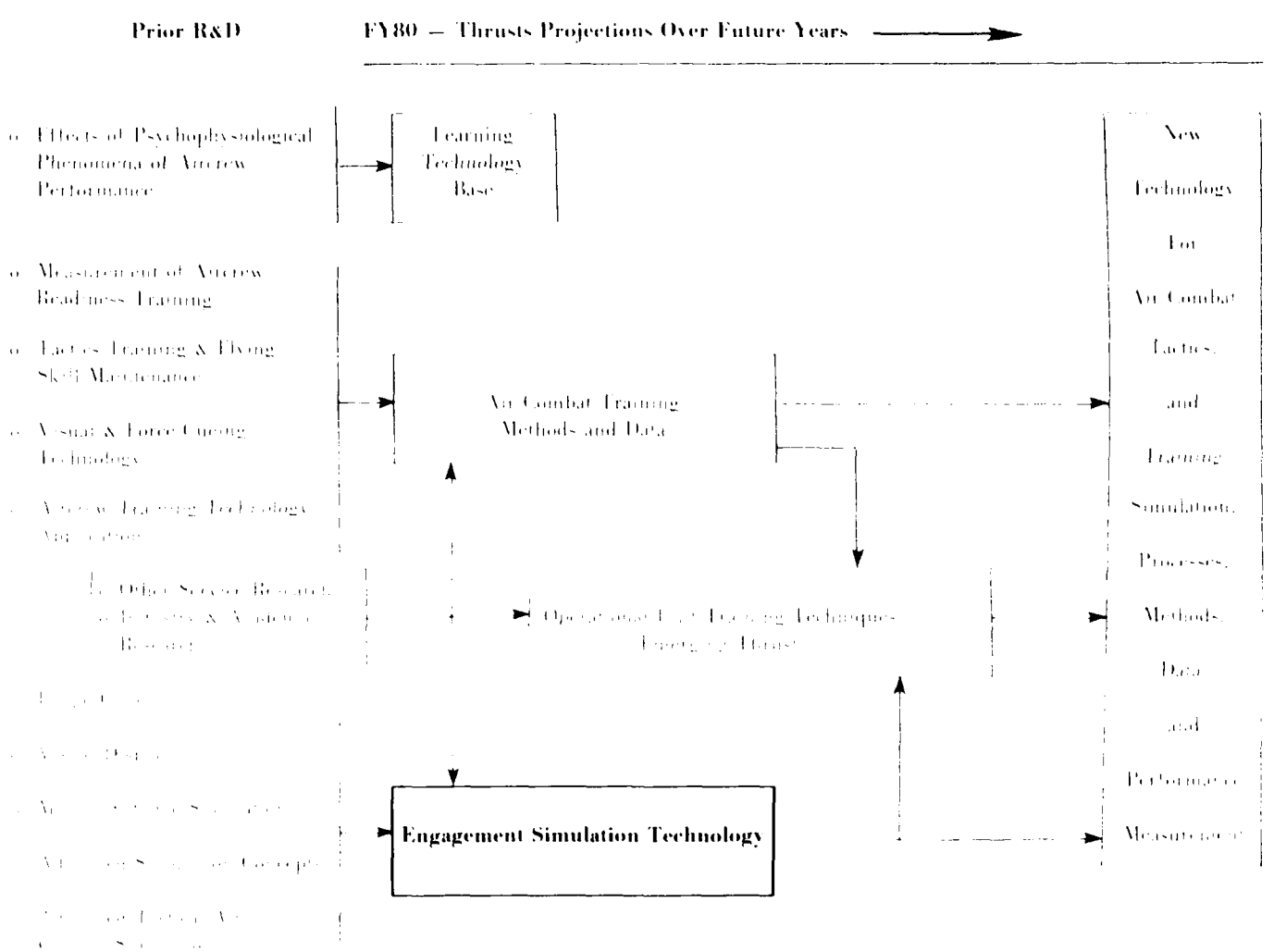
Description: The objective of this research is to develop physiological measures of pilot attention and workload. These measures will ultimately be used in conjunction

with behavioral measures of pilot attention and task difficulty in order to optimally structure flight simulation training programs and equipment. One initial objective has been to establish laboratory procedures for handling the large quantities of data involved in psychophysiological research and to ensure that all components of the computer laboratory were functioning properly. The variables of heart rate, skin conductance, respiration rate, pulse transit time, cortical evoked potentials, and eye movement have not been investigated simultaneously in previous research. A second major objective of this study is to investigate the interrelationships of these variables with each other and with performance on behavioral information processing tasks. A simplified laboratory flight simulation provides the behavioral task which is being used to study the various physiological variables. Heart rate, skin conductance, respiration rate and pulse transit time are being studied as indicators of autonomic arousal. The cortical evoked potentials are related to attentional state and the complexity of stimuli emulation environment.

Utilization: The measures of arousal (heart rate, skin conductance, respiration rate, and pulse transit time) reflect, in a gross sense, the degree of subject involvement in the task. Also, both the early and late components of the cortical evoked response vary with task difficulty and performance. Assessment of human performance has become more difficult as the complexity of man-machine systems has increased. The point has been reached where behavioral research must step beyond the limits imposed by quantifying behavior in terms of motor responses only. Psychophysiological assessment of the internal state of the operator shows promise of providing the tools to take this step. By combining behavioral and psychophysiological assessments, a more comprehensive profile of human performance should emerge. This should permit a greater understanding of the conditions under which performance deteriorates and should point to training techniques and training equipment configurations that will maximize pilot performance.

AFHRL Contact: George Buckland
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

ENGAGEMENT SIMULATION TECHNOLOGY



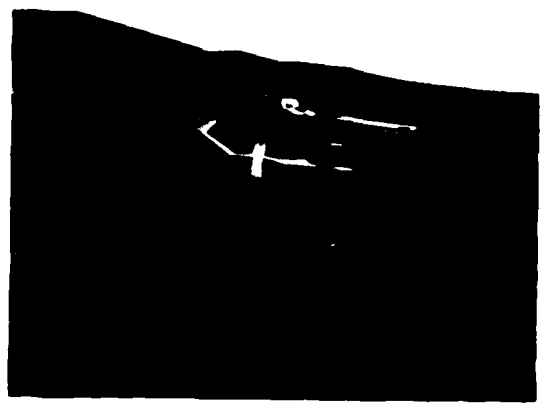
TECHNICAL ACHIEVEMENTS

Title: F-16 Aircraft Turbulence Study

Description: A study is underway to determine whether incorporating various levels of turbulence in the visual scene, instruments and G-Seat of the Advanced Simulator for Pilot Training (ASPT) F-16 cockpit can improve in-simulator performance in a subsequent moderate turbulence condition. Aircraft motion due to turbulence is not predictable by the pilot. When it occurs, it informs the pilot of a condition which must be reacted to in order to control the aircraft. In this study, motion due to turbulence was simulated by instrument and visual scene jitter and by the inflation and deflation of G-Seat bladders. Platform motion was not used. The 18 Tactical Air Command pilots participating in this study all had previous experience in fighter aircraft and were transitioning to the F-16. Nine of these pilots were trained in the ASPT/F-16 configuration on three tasks at three different levels of turbulence. The tasks were instrument landing system, 30-degree dive bomb, and strafe. These pilots were the experimental group. The other nine pilots received ASPT/F-16 training on the same three tasks but with no turbulence. These pilots were the control group. Pilots in the experimental group experienced task/turbulence conditions in a specially-balanced arrangement that exposed each pilot to all the conditions in a unique order.

Utilization: It was expected that this study would show that prior training with turbulence would enable pilots to perform better in subsequent turbulent conditions than would pilots who had not received prior training. Preliminary analysis of results shows that this expectation was not realized. As a matter of fact, the control group seems to have out-performed the experimental group on the criterion trials. Apparently, the training with turbulence was disruptive rather than beneficial. A tentative conclusion to be drawn is that, since the subjects were all experienced fighter pilots, they already had learned how to react to turbulence. Turbulence experienced by the experimental group did not improve skills which were already developed. Turbulence may have distracted the experimental group from the task of learning the F-16, resulting in reduced criterion performance compared to the control group.

Benefits: This research can influence the utilization of the syllabus for the F-16 Full Mission Simulator.

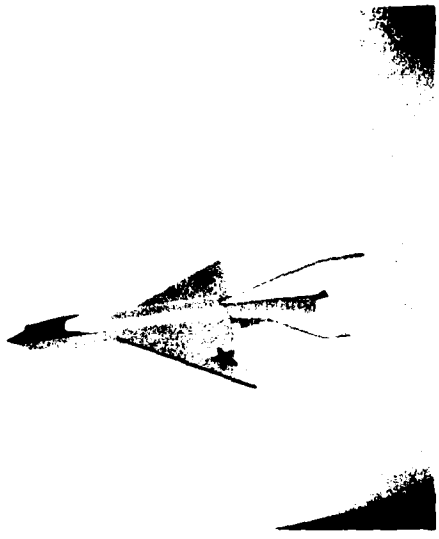


ASPT CIG Hill Air Force Base Environment

AFHRL Contact: R. Woodruff
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-0561
Commercial (602) 988-6561

Title: Interface Between the Simulator for Air-to-Air Combat and the Advanced Simulator for Pilot Training

Description: The SAAC-ASPT Interface (SAIN) Project demonstrated that two simulators at widely separated geographical locations could be used in an interactive mode for air-to-air combat, aerial refueling, and various tactical scenarios. The devices used were the Simulator for Air-to-Air Combat (SAAC) and the Advanced Simulator for Pilot Training (ASPT). The SAAC simulator is installed at Luke AFB, approximately 30 miles west of Phoenix; ASPT is installed at Williams AFB, approximately 30 miles east of Phoenix. SAAC is comprised of two F-4 cockpits mounted on synergistic six-degree-of-freedom motion systems. Each cockpit is enclosed by eight cathode ray tubes (CRTs) and collimating windows displaying the visual scene and



ASPT MIG-21 Moving Model

affording the pilot a nearly unlimited field of view. The visual display is provided by an electronic synthetic terrain generator and a camera model aircraft image generator. Each pilot is furnished a representation of the maneuvering of the adversary aircraft. G-seats and G-suits provide vibration cues to supplement those from the motion system. The gunfire trajectories and missile trajectories are computed so that the scoring system can accurately assess hits during simulated engagements. Each cockpit in the ASPT is enclosed within a seven-channel visual display subsystem. The system is presently configured as an A-10 aircraft on cockpit "A" and as an F-16 aircraft on cockpit "B"; however, it can simulate a variety of aircraft. Various incompatibilities existing between the two systems had to be overcome; for example, SAAC operates at an iteration rate of 20 times per second whereas ASPT has a rate of 30 times per second. The most inexpensive manner of integrating these two computer-controlled systems was through dedicated land lines leased from the telephone company.

Utilization: The following capabilities were demonstrated: Both simulators could be preset to a common initialization point using predetermined displacements. The pilot in the SAAC could observe the ASPT represented as a MIG-21. Simultaneously, the pilot in the ASPT observes the SAAC pilot maneuvering, also represented by a MIG-21 moving model. The pilots are free to perform any required change in attitude or power necessary in a real-world situation to obtain a kill. Each system independently determines whether its pilot has been successful in causing the destruction of the other participant. A confirming message from the winning system computer informs the losing system computer of the kill. At this point, both systems freeze in the condition existing when the victim was terminated. This system has demonstrated that it is feasible to interface modern simulators which are physically remote from each other. The application of this principle with utilization of more sophisticated methods of data transmission will permit a new spectrum of simulator usefulness in improving and maintaining the combat skills of operational aircrews.

Benefits: Theoretically it had been assumed that two geographically separated simulators could be interconnected to operate in an integrated mode. This low cost, low priority project proved for the first time that it could be done. The project serves as the foundation for practical implementation of similar but more sophisticated utilization of this mode of simulator operation.

AFHRL Contact: Glen P. York
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: High G Cue Optimization

Description: Research was conducted to optimize, in terms of both hardware response and software driving philosophies, the effectiveness of pneumatically operated helmet loader, G-seat (air bladders and bellows), and G-suit flight simulation subsystems for high performance aircraft, such as the Advanced Simulator for Pilot Training (ASPT) F-16 aircraft configuration. The hardware effort was directed at improving the response lag and bandpass of the G-seat system through bench test analysis of the limitations of each component. The results of the software drive philosophy research indicate the following: (a) The pressure cue versus position cue driving philosophy dichotomy may be partially solved by applying pressure cues in a specific G-range while position cues become dominant in another G-range. (b) Proper cues for ground accelerations may be quite unlike those appropriate in air maneuvers (perhaps another area of pressure versus position dominance). (c) Original driving philosophies for roll maneuvers may need to be revised or even reversed; various components of the G-seat system should respond based upon roll velocity, while other components should respond based upon roll acceleration. (d) Original driving philosophies for many components of the system based upon translational accelerations may need to be revised in order to improve G-simulation, especially for high performance aircraft.

ASPT F-16 Cockpit Module

(e) Use of a G-suit or helmet loader in conjunction with a G-seat will alter the optimum drive philosophy. (f) Response time improvements can make buffeting, runway rumble, and other special effects feasible in a pneumatic system. (g) Drive differences based on gear up or gear down can enhance landing cues from the G-seat system. NASA/Langley's helmet loader system was on loan to the Air Force Human Resources Laboratory for evaluation in the F-16 project. Technical problems of pilot comfort, freedom of movement, and cue levels were worked on and improved. Work in this test and evaluation mode is continuing.

Utilization: This research is expected to be of use in future simulator design. Goodyear Aerospace visited the facility to experience and discuss these results, and Singer/Link is aware of some of these findings.

Benefits: Better G-cues for pilot training in simulators (especially high performance aircraft), emulation on ASPT of G-cueing designs.

AFHRL Contact: David R. Lee
AFHRL/OTE
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Simulator for Air-to-Air Combat System Refinement and Enhancements

Description: The system enhancements implemented on the Simulator for Air-to-Air Combat (SAAC) included the addition of a video gunsight camera, expanded and refined AIM 9 and AIM 7 missile trajectory envelopes, and new program load (Dial-a-Plane) procedures which provide a flexible combination of aircraft performances available for operational training and research.

Utilization: The video gunsight camera portrays on the instructor console the visual scene of the engagement as viewed by the pilot looking through the lead-computing gunsight display. The software revisions to the missile envelopes refine the method by which hits are calculated, thereby determining weapons scoring more accurately and hence more credibly. Selective aircraft performance load greatly expands the utility of the simulator by permitting performance simulation in a number of aircraft configuration in either or both cockpits.

Benefits: The enhancements incorporated greatly improve the training utility and research capability of the SAAC. The instructor pilot at the console can more readily assess tracking performance of pilot students by viewing the gunsight vehicle and target as seen by the pilot being observed. Improved missiles minimize possible negative training and Dial-a-Plane opens the feasibility of tactics development against dissimilar aircraft through the use of simulation.

AFHRL Contact: Robert L. Makinney
AFHRL/OTGO
Luke AFB AZ 85309
Autovon 853-7180
Commercial (602) 935-7180

Title: Advanced Simulator for Pilot Training: Multiple Moving Models Update

Description: The Advanced Simulator for Pilot Training (ASPT) was delivered with the capability of displaying a single moving model in the visual environment. This was adequate for formation flight and other tasks requiring a single moving model. With the change in laboratory thrusts to investigate air combat tactics and training, additional moving models in the visual environment were required to provide moving targets (tanks, trucks, aircraft) and threat simulations (surface-to-air missiles). To satisfy this requirement it was necessary to acquire additional computational power to perform the frame one computations on the ASPT visual system. The two Systems Engineering Laboratory (SEL) 86 computers which were supplied with ASPT to perform the frame one computations were replaced by four SEL 32/75 computers and an array processor. This, together with an extensive modification to the General Electric special purpose visual image generation computer, allows display of up to seven moving models simultaneously.

Utilization: This update to the ASPT visual system is currently undergoing acceptance testing by the Air Force, having been successfully integrated to the ASPT flight simulation system.

Benefits: The increased capabilities provided by the multiple moving models will enable research into air-to-ground combat tactics using moving targets, forward air controller aircraft, and surface-to-air missiles simultaneously in the visual environment. For air-to-air combat tactics, the system will be able to provide multiple enemy aircraft. These capabilities, together with the A-10 and F-16 cockpits on ASPT, greatly enhance the research potential of the ASPT simulator system.

AFHRL Contact: Terrance K. Templeton
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Psychophysical Criteria for Visual Simulation Systems

Description: This effort studied a prioritized list of psychophysical aspects of visual simulation systems for military flight training simulators. The available literature, operational experiences of simulator commands, and current research program data were assembled, organized, reviewed, evaluated, and summarized to provide psychophysical criteria for visual displays subsystem.

Utilization: The study provided an assessment of the effect on pilot performance of visual system characteristics, and methods to minimize negative features.

Benefits: The study report provides a valuable reference document for designers of visual systems.

AFHRL Contact: T.M. Longridge
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Pilot Performance and Stress

Description: Biochemical measures of pilot stress were taken in conjunction with Undergraduate Pilot Training and A-10 aircraft surface attack training. The results established that (a) there is a consistent relationship between instructor pilot techniques, and student pilot stress, (b) stress incident to A-10 surface attack simulator training is not significantly different from that observed in the aircraft, (c) the establishment of competence in both simulator and aircraft tasks is associated with measurable changes in biochemical substrates, and (d) experienced pilots exhibit a pronounced stress response when exposed to high threat/high workload tactical simulator scenarios.

Utilization: These results provide validation of the effectiveness of advanced simulation training for eliciting realistic stress levels.

Benefits: The results suggest that biochemical techniques can be usefully employed as metrics to structure training for optimal stress elicitation.

AFHRL Contact: T.M. Longridge
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Video Disk Technology Application to Real Mission Visual Simulation Scenarios

Description: A study effort has been initiated to investigate the extension of Vought Corporation CAPTV technology to combat fighter training requirements. The study involves new developments in three areas of the full color wide field-of-view visual system now under construction for the Navy A7-WST Project. The first area of study is the low altitude image transformation algorithms to reduce data base requirements. The second study area is image data base storage architecture and alternate sources such as non-real-time computer-generated imagery. The third study area is the addition of moving models, targets, and other computer-generated imagery effects.

Utilization: The successful development and integration of this technology could represent a major breakthrough in visual simulation. The non-processing intensive nature of the system would allow a quantum leap forward in terms of visual scene detail, texture, and realism compared to the computation bound approach in total computer-generated imagery systems. The terrain textural fidelity capability inherent in this approach may finally provide realistic simulation of real-world tactical environments. Especially notable is the potential for simulation of realistic missions requiring low-level navigation for threat avoidances.

AFHRL Contact: R. Bruce McCreary
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Advanced Visual Scene Simulation

Description: Conceptual designs for advanced computer image generation (CIG) systems are being developed in the first phase of a technology demonstration program. Advanced algorithms and techniques, which give a higher fidelity representation of the terrain scene than edge based CIG systems, are being investigated. Thus, aspects of CIG visual and sensor simulation being considered include data base structure, color/tonal computations, priority determination, resolution, real-time processing efficiency, image quality, textured surfaces, shadowing anti-aliasing, terrain/hydrographical cultural features and special effects. Compatible techniques are to be integrated into a feasible system concept which would minimize objectionable artifacts in present simulations and provide better scenes for training applications. In order to minimize the risks, two competitive contracts have been awarded for the first phase. During later phases of this effort, demonstration products validating the design should be produced. Eventually, a new generation CIG system could be produced based on the advances made in this study if cost-effective components can be produced within the state of the art.

Utilization: Higher fidelity visual/sensor simulation would enable training some tasks which are currently not practical due to system limitations. In applications for both real-time and non-real-time CIG mission oriented training, the simulation would be more effective.

AFHRL Contact: Wilburn O. Clark
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Visual Scene — Area of Interest

Description: The computer image generation (CIG) system for the Advanced Simulator for Pilot Training (ASPT) is limited in the number of edges, and hence detail, it can display at one time. In order to provide more visual detail in the pilot's area of attention, Phase I of the area of interest (AOI) concentrated the edges into a selectable variable sized square ranging from 1 by 11 to the full display. Only selected features, such as mountain ranges, appear outside the AOI. In Phase I, the objects were deleted or reinstated as entire objects flashing into or out of the visual display. Phase II AOI, which is awaiting debugging, acts on the various elements of the object instead of the entire object providing a much smoother, and therefore, less distracting transition at the AOI boundary.

Utilization: AOI Phase II will significantly enhance pilot performance in tactical combat simulation applications by providing, with minimum distraction, the necessary visual detail otherwise available only from much larger and more expensive CIG systems.

AFHRL Contact: Eric G. Monroe
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Advanced Simulator for Pilot Training (ASPT) Alternate Display

Description: The cathode ray tubes (CRTs) used for the Advanced Simulator for Pilot Training (ASPT) are rapidly approaching their projected life span. Sixteen replacement CRTs will be required within the next 24 months, necessitating a combined refurbishment and new CRT production rate which exceeds past performance of the CRT vendor. An attempt to alleviate this situation will be investigated by replacing one of the present CRT assemblies with a 1000-line light valve projector, lens, and rear screen assembly.

Utilization: One channel of the ASPT display will be replaced with a light valve projector in order to assess its performance, maintainability, and reliability. If it is successful, the light valve projector will provide the ASPT display system with one alternate source which *should* be more readily available and reliable on a competitive basis. This would also provide additional reliability and maintenance data for similar projects.

AFHRL Contact: Eric G. Monroe
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: Integrated Cueing Requirements Study

Description: The objective of this effort is to identify, consolidate, and synthesize sensory and perceptual data germane to the engineering design and utilization of air training devices.

Utilization: The product of this effort will be a comprehensive data base for utilization by Air Training Device design engineers and in the development of equipment specifications/requirements.

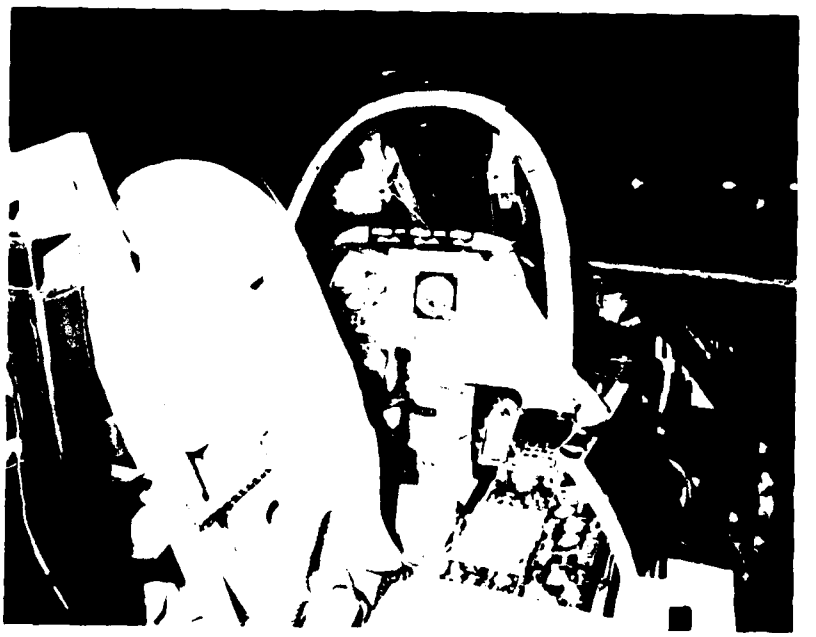
AFHRL Contact: T. M. Longridge
AFHRL/OTG
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

Title: A-10 Aircraft Training and Research Engineering Development

Description: Phase I of the Advanced Simulator for Pilot Training (ASPT) A-10 Project consisted of modifying cockpit "A" of the ASPT from a T-37 to an A-10 configuration. The modification provided conversion and tactical weapons delivery training for the Tactical Air Command (TAC) and the capability for the Air Force Human Resources Laboratory to conduct training research. Phase II, which provides advanced conversion, manual reversion, and hostile tactics research and training, has been completed. The Phase II cockpit of A-10 is an in-house, modular design and is capable of being used for research studies not directly connected with A-10 aircraft or TAC training. Research performed this year included studies of the Inertial Navigation System (INS), heads-up display symbologies for the A-10 aircraft, level-of-detail of computer image generation required for a KC-135 tanker model to accomplish air refueling training, and tactics used for low-level flight in a high threat environment. Continuing engineering research and development includes expanded simulated hostile environments and weapons systems, such as the Maverick missile, and extended low-level tactical navigation.

Utilization: The "A" cockpit of the ASPT, presently in a modular A-10 cockpit configuration, will be used for TAC A-10 training until the delivery of A-10 simulators to TAC. It will also be used for research on high-threat environment tactics. By providing a research tool for simulated hostile environment studies; visual display requirements, force cueing, and advanced instructional methods, ASPT A-10 simulation provides the Air Force with a valuable flying training research tool. This simulation also provides TAC with a unique opportunity to acquire valuable simulation training during research studies.

AFHRL Contact: Lt Col Samuel T. Hannan
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



ASPT A-10 Cockpit Module

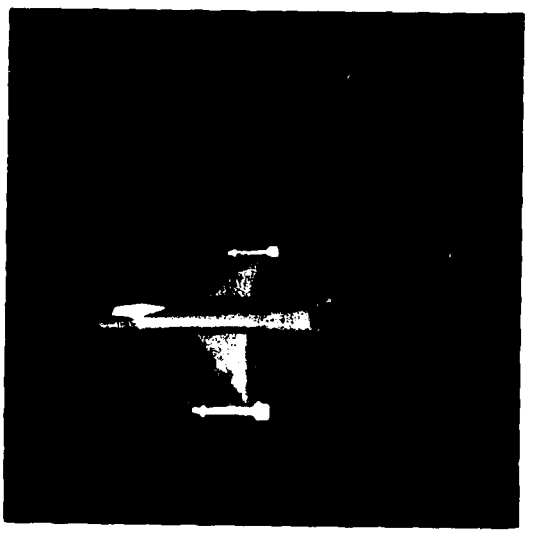
Title: F-16 Aircraft Air-to-Air-Capability

Description: The F-16 aircraft configuration simulator on the Advanced Simulator for Pilot Training will soon have a full air-to-air capability. This capability will include radar, heads-up display, and stores management subsystem integrated to provide the pilot with four different air-to-air combat modes of operation. The pilot will also receive real-time scoring of the 20 mm gun and the AIM9J or AIM9L missile.

Utilization: This capability will provide a device for limited research in the air-to-air realm of combat operations. This will also enhance the present ASPT air-to-ground capability, providing a simulator that is operational throughout the tactical combat environment.

AFHRL Contact: Major Richard Engel
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

AFHRL Contact: Lt Ray Sheen
AFHRL/OTF
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561



ASPT CIG F-16

Title: Implementation of a Helmet-Mounted Sensor/ Helmet-Mounted Display on the Advanced Simulator for Pilot Training

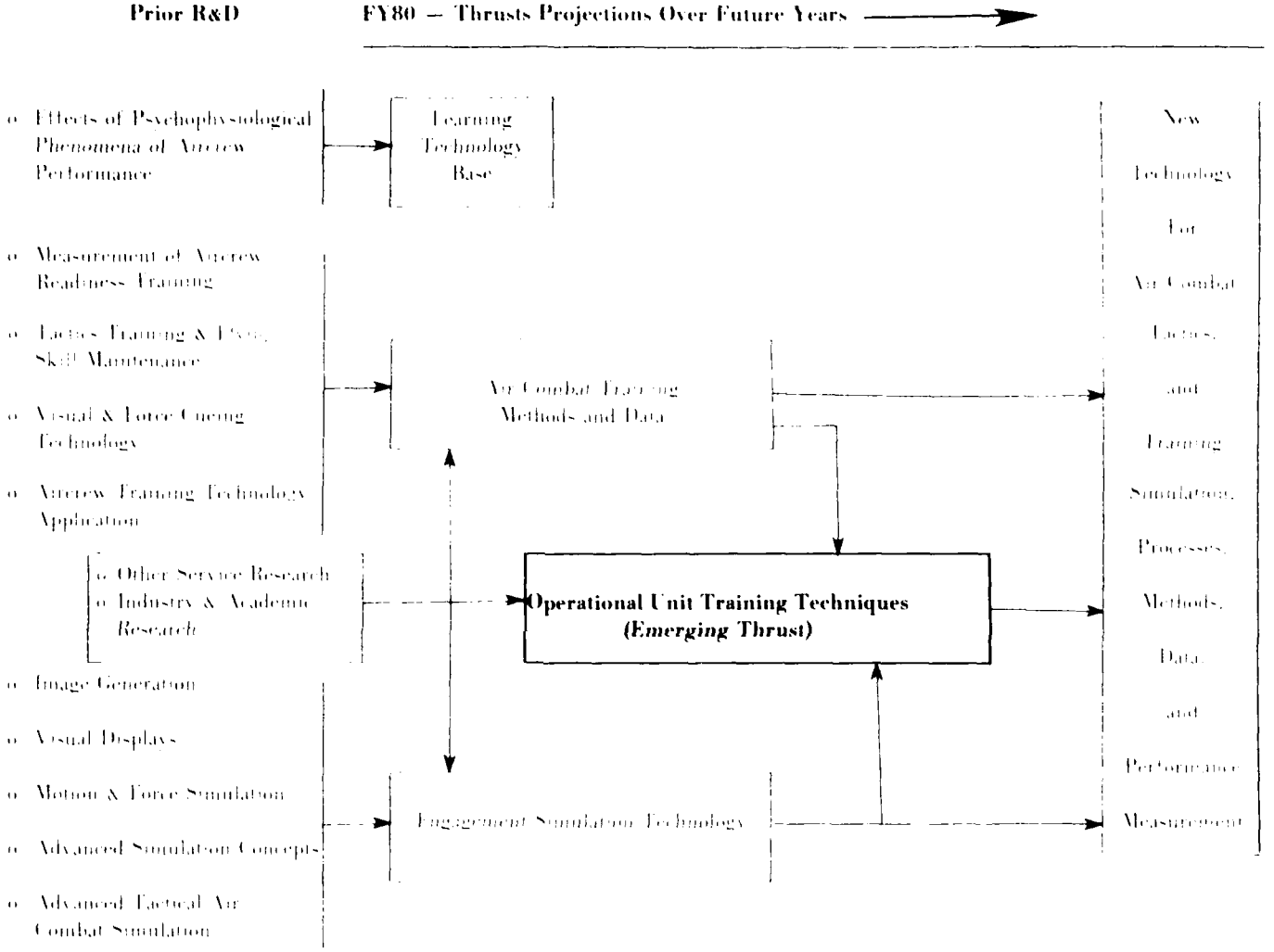
Description: An effort is underway to integrate state-of-the-art equipment with Advanced Simulator for Pilot Training (ASPT) as a follow-on to the engineering feasibility demonstration of the helmet-mounted sensing and display equipment borrowed from the Aerospace Medical Research Laboratory. The new helmet-mounted sensor (HMS) utilizes an electromagnetic field detector rather than an infrared detector and provides X, Y, Z (roll, pitch, yaw) data. This information is supplied to a greater degree of accuracy for a wider range of helmet motion, compared to the previous equipment. The HMS/ helmet-mounted display (HMD) will be implemented in both ASPT cockpits. The HMD consists of a small cathode ray tube mounted on the side of the pilot's helmet, projecting a display on a combining glass in front of the pilot's eye. This system presents either a high resolution range (less than 1 to 3 arc minute) monocular (right or left eye) central vision area (1 to 10 degree field-of-view (FOV)) display, or two units may be combined to provide binocular coverage in conjunction with the ASPT full FOV display. The HMD collimated image is at the same focal distance as the background ASPT wraparound display and will be optically combined with the background which is observable with both eyes. The system also allows unconstrained pilot movement within the cockpit and will provide a correct image perspective with occlusion by the pilot's aircraft.

Utilization: Installation of the HMS equipment will provide the capability to utilize the ASPT in pilot workload, head-in cockpit, head versus aircraft attitude, and visual FOV studies. The addition of HMDs in both ASPT cockpits will vastly expand the research potential to include key issues in visual flight simulation. Studies may be conducted to determine resolution, scene detail, and FOV requirements for various flying tasks. HMDs may be evaluated for their training potential in air combat maneuvering, air combat tactics, stand-off weapons systems, and associated tactics. Evaluation may also be performed on fly-by-sensor system display, Maverick missile helmet displays, and helmet display of aircraft data. With the F-16 and A-10 cockpits, studies could also be performed to develop F-16 and A-10 tactics training scenarios. The findings from studies using this equipment should be very useful in designing specifications for future flight simulators having the potential of resulting in considerable dollar savings, reduced training time, enhanced operational readiness, and increased capabilities and training effectiveness.

Helmet Mounted Sensor/Helmet Mounted Display

AFHRL Contact: Lt. C. Monroe
AFHRL/OTI
Williams AFB AZ 85224
Autovon 474-6561
Commercial (602) 988-6561

OPERATIONAL UNIT TRAINING*



*As noted in the Chief Scientist's report and the thrust area descriptions, the Operational Unit Training Thrust is *emerging with essentially no effort expended during* FY 80. There is one technical achievement associated with prior R&D which is reported subsequently. No ongoing R&D efforts are provided since this thrust will be formally initiated in FY 82.

Title: A-10 Manual Reversion Flight Control System Simulation Research

Description: The A-10 aircraft incorporates an emergency backup control mode, the Manual Reversion Flight Control System (MRFCS). Maintaining effective control in this mode is a demanding pilot task, but it is not practiced in the flying training syllabus. Because current plans call for training this skill using simulation, information is needed on the effectiveness of selected simulator visual and force cues as utilized by experienced A-10 pilots to maintain aircraft control and land when in the MRFCS mode. Twelve combat-ready Tactical Air Command pilots served as subjects for the study. Each subject flew 24 trials in the Advanced Simulator for Pilot Training (ASPT). The subject's task was to remain airborne and land the aircraft after experiencing either a simple single engine failure or a failure requiring MRFCS. These failures occurred at three different points in a pre-established flight profile.

The study design was based on a high-order multivariate analysis of variance and used the following as independent variables: (a) two field-of-view levels (full and restricted), (b) two levels of platform motion (six degrees of freedom and none), (c) two failure states (simple single engine failure and MRFCS), (d) three failure points (viewed as producing three discrete piloting tasks, or maneuvers), and (e) three trials of landing the aircraft under the same simulator configuration and in the same failure state. It was found that: (a) a large field of view enhanced the pilot's control of the aircraft, (b) platform motion had no influence on aircraft control, (c) aircraft control was far more difficult in the MRFCS mode than in the simple single engine failure state, (d) point of failure was a significant variable reliably affecting pilot control of the aircraft, and (e) pilot performance improved as a function of practice (trials).

Utilization: This study has demonstrated that the task of learning to fly and land the A-10 in the MRFCS mode is independent of simulator platform motion, but is strongly dependent on field-of-view cues. The task, as performed in the ASPT, is most trainable. Thus a critical skill which is too hazardous to practice in actual flight may be learned in the safety of a simulator.

Benefits: As concerns simulator design requirements, considerable cost savings can be realized through the elimination of expensive platform motion bases. For the Tactical Air Command, the inclusion of MRFCS training in the syllabus has the potential to save numerous pilots and aircraft.

AFHRL Contact: T.H. Gray
AFHRL/OTC
Williams AFB AZ 85224
Autovon 474-6761
Commercial (602) 988-6561

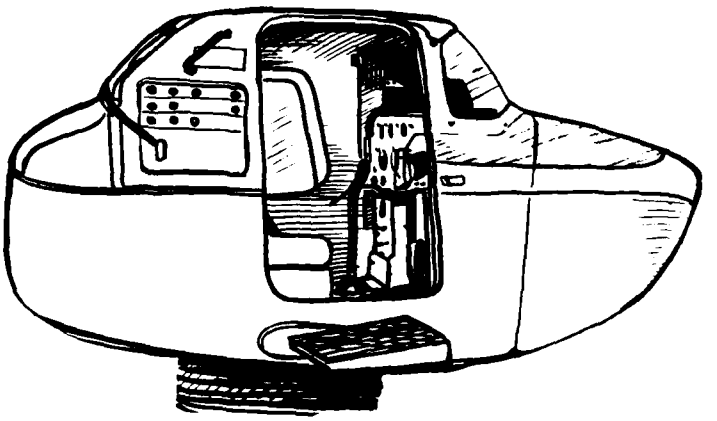

AIR FORCE
11369

AD-A100 331 AIR FORCE HUMAN RESOURCES LAB BROOKS AFB TX F/G 5/9
AFHRL ANNUAL REPORT FY 80.(U)
1980

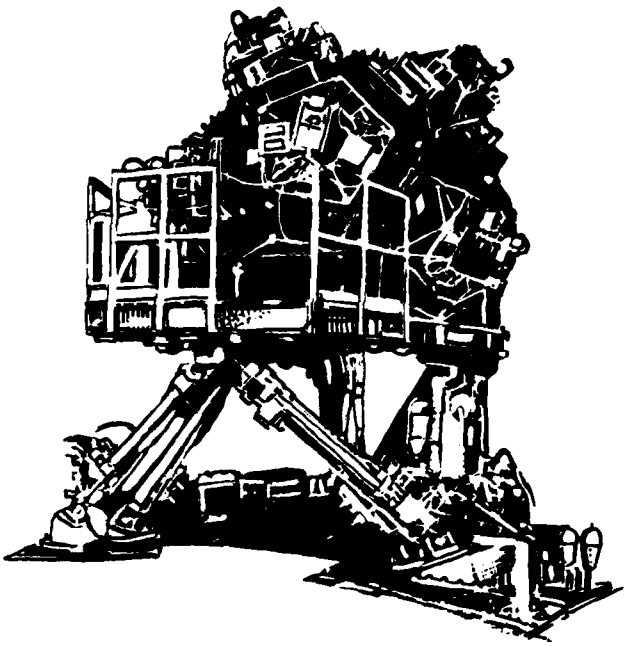
UNCLASSIFIED NL

END
DATE FILMED
7 81
DTIC

AFHRL



LINK GENERAL AVIATION TRAINER I



ADVANCED SIMULATOR FOR PILOT TRAINING

PAST

The Air Force Human Resources Laboratory (AFHRL), established in July 1968, continues a long tradition in military psychology. During the First World War the Army selected and assigned men with the help of the Army Alpha and Beta Tests. Between August 1917 and January 1919 nearly two million men had been examined. This was the first aptitude test ever based on national norms. It marked the beginning of large scale mental measurement, both as a tool of personnel management and as a technique of modern psychology.

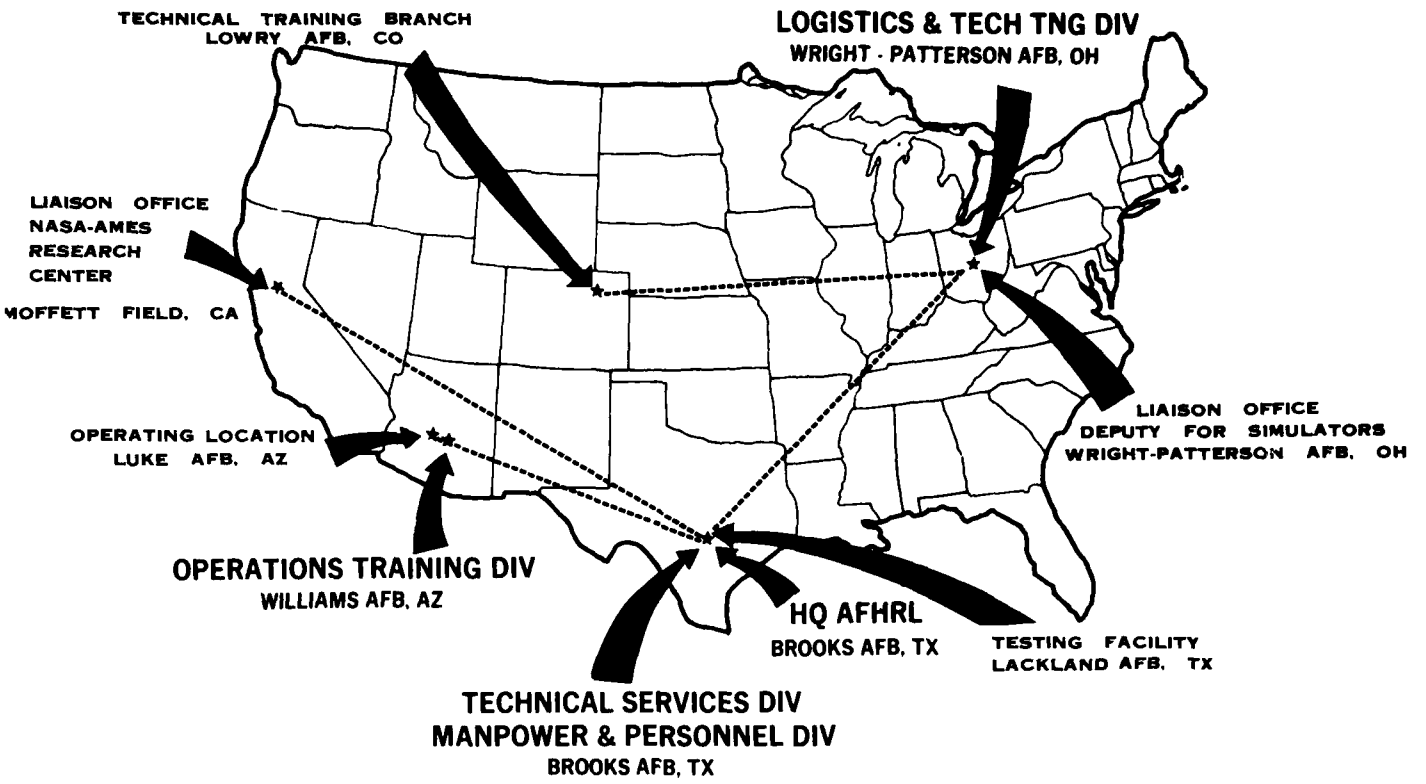
The Second World War saw a quantum leap in the use of military psychology. Over nine million men were administered the Army General Classification Test, and a number of Psychological Research Units were organized by the Army Air Force. Such units were established at Maxwell Field, Alabama; at Kelly Field, Texas; at Lackland AFB, Texas and at Santa Ana, California. Through something of an evolutionary process, these initial research units developed into the Human Resources Research Center established at Lackland AFB, Texas in July 1949.

Continuing organizational development replaced the Human Resources Research Center with the Air Force Personnel and Training Research Center in February 1954. In 1958 the Personnel Research Laboratory became an element of the Wright Air Development Center (later Division). As of 1 February 1962, it was transferred to the Aerospace Medical Division of Air Force Systems Command, and continued operation at Lackland AFB until July 1968. At that time, AFHRL was established with headquarters at Brooks AFB, Texas.

PRESENT

Since World War I, the military services have developed progressively more accurate and efficient tests to screen applicants for enlistment and to identify the differing abilities required by the widely divergent military occupational specialities. Today the Manpower and Personnel Division of AFHRL continues the task of *matching the right person* with the right job. Ongoing research and development includes the development of aptitude and interest measures; methods for collecting, analyzing, and modelling occupational information; and the establishment of physical, aptitude, experience, and education requirements for specific jobs. However, personnel selection and assignment is only one area in human resources research today. Equal, if not greater, attention is given to research and development to improve tools and techniques for incorporating logistics factors into the design, development, evaluation, and life cycle costing of Air Force weapon systems. Also R&D encompassing the utilization of simulators, flying vehicle operation, and missile and space systems constitutes a high percentage of AFHRL efforts. Other efforts focus on flying training technology; on developing, testing, and evaluating existing and newly-developing hardware, programs, procedures; and on techniques for improving all phases of flying training programs. The laboratory is conducting research in flying skills maintenance and reacquisition, low level navigation, air-to-air refueling requirements, air combat maneuvering, and pilot performance in hostile high threat environments. Thus, it is evident that the complexities of modern warfare have greatly expanded military research requirements. The man-machine-performance interface now plays a major role in AFHRL research and development.

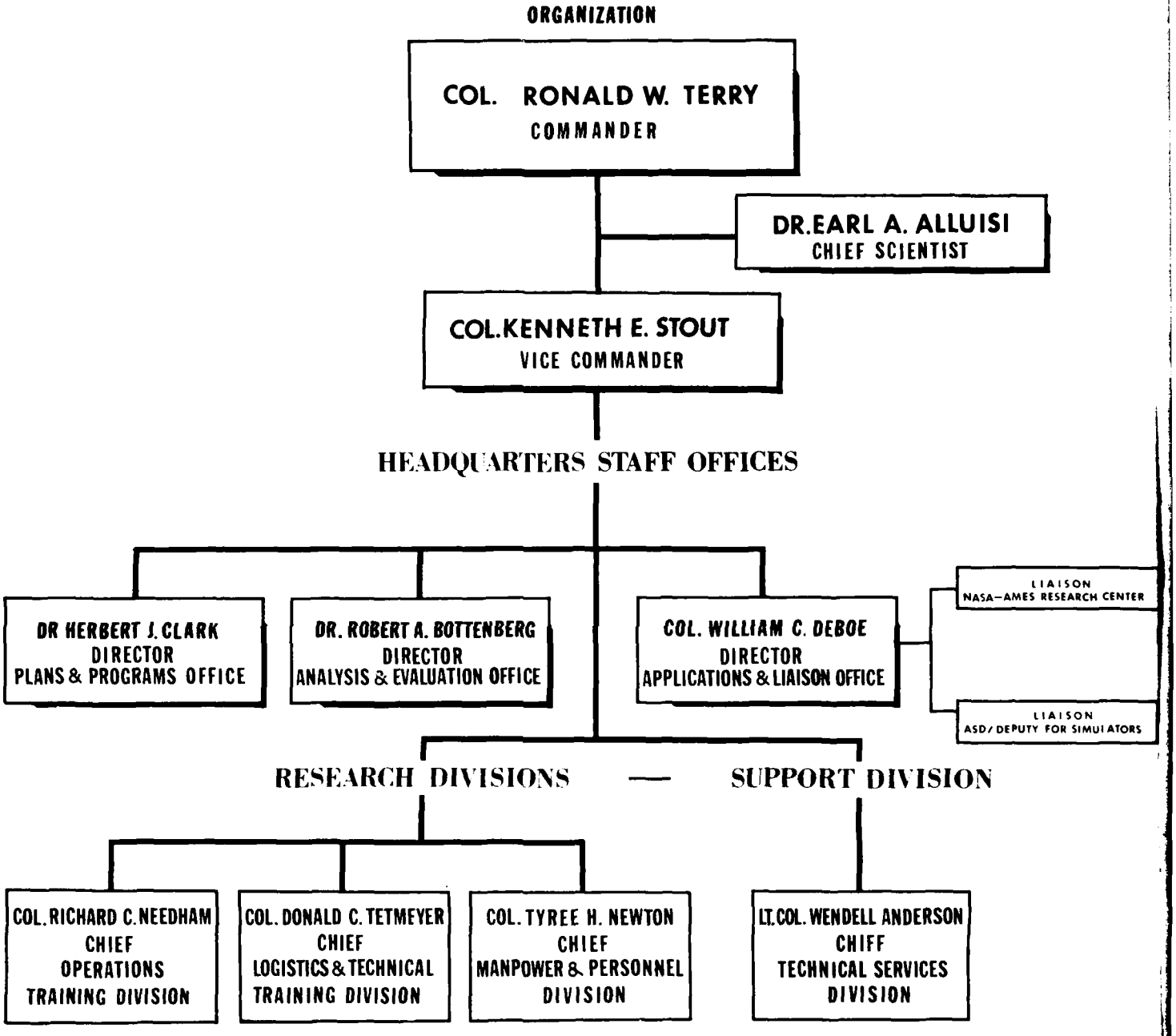
AFHRL GEOGRAPHICAL LOCATIONS



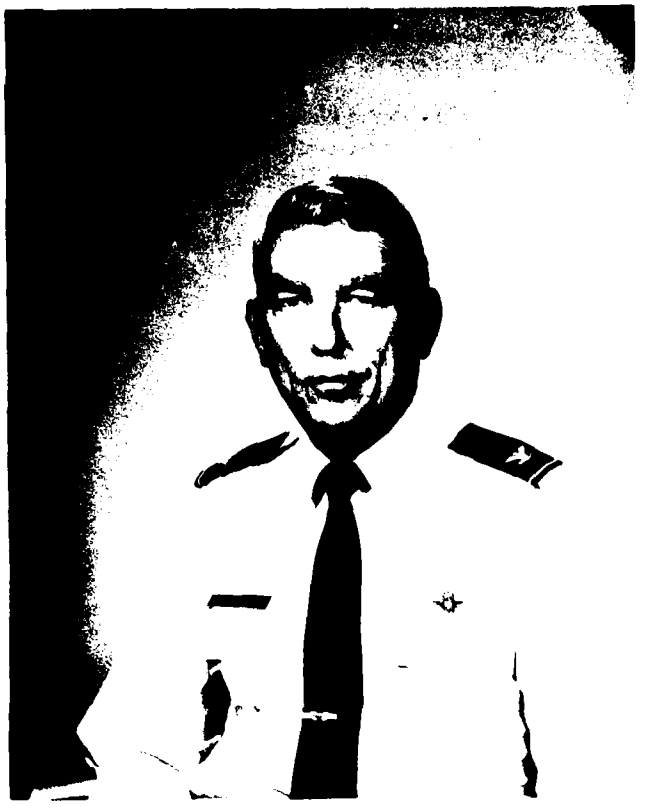
The accompanying map depicts the geographical placements of the AFHRL divisions and liaison offices. The Logistics and Technical Training Division located at Wright-Patterson AFB, Ohio, conducts R&D on logistics, technical training, team-training and team performance in ground based systems. The Manpower and Personnel Division located at Brooks AFB, Texas, supports the Air Force personnel system by developing improved methodologies for procurement, selection, assignment/reassignment, utilization, evaluation and retention of personnel. The Operations Training Division located at Williams AFB, Arizona, executes basic research, exploratory and advanced development to improve quality and combat-effectiveness of aircrews. The Technical Services Division located at Brooks AFB, Texas, plans, allocates, and controls facility and manpower resources, directs the scientific and technical information program, provides technical editing and composition service, provides project analyses and computer programming support and develops data bases and operates the computer system.

From its liaison office at NASA-Ames Research Center, Moffett Field, California, AFHRL coordinates research in full-mission flight simulation and flight management systems. AFHRL has a second liaison office with the Deputy for Simulators, Aeronautical Systems Division, Wright-Patterson AFB, Ohio. The mission of the Luke AFB, Arizona, operating location is to conduct research with the Tactical Air Command on simulation training for air-to-air combat. At Lowry AFB, Colorado, a branch of the Logistics and Technical Training Division is collocated with a Technical Training Center of Air Training Command (ATC). This enables the Laboratory to work closely with ATC in R & D related to training. A final coordinating office is a personnel testing facility at Lackland AFB, Texas.

AIR FORCE HUMAN RESOURCES LABORATORY



HEADQUARTERS STAFF OFFICES



VICE COMMANDER

Colonel Kenneth E. Stout

The Vice Commander assists the Commander in the performance of his command function and commands the Laboratory during absences of the Commander. The Vice Commander chairs the Laboratory's Corporate Planning Group (CPG) and the Corporate Planning Group Executive Committee (CPGEC).

The Corporate Planning Group is responsible to the Commander for recommendations and priority assignments on laboratory policy, short- and long-term goals, and overall mission and thrust alternatives. The CPG consists of the Vice Commander, the Chief Scientist, the Directors of Headquarters Staff Offices, the Division Chiefs, and the Executive Officer (Recorder). The CPG meets at least once annually.

The Corporate Planning Group Executive Committee consists of the Vice Commander, the Chief Scientist, the Directors of Headquarters Staff Offices and the Executive Officer (Recorder). The CPGEC acts for the CPG between CPG meetings, and meets at least once monthly.

Normal functions of the CPGEC are the following:

a. Upon the Commander's approval, the committee may disseminate policy or guidelines to, or request reports or information from, any AFHRL organization element or other offices and agencies.

b. The committee reviews the Technical Advisory Board recommendations regarding the Laboratory's RDT&E program for compliance with policy, goals, objectives, and priorities.

c. CPGEC forwards recommendations regarding the RDT&E program to the Commander, with comment.

d. Upon the Commander's approval, the CPG Executive Committee forwards the Commander's Approved RDT&E Program to the operating RDT&E Divisions and Headquarters Staff Offices through the Plans and Programs Office.

e. Finally, the committee makes recommendations to the Commander for assignments of Divisional and Headquarters Staff Office responsibilities for added efforts, including new technical thrusts.

PLANS AND PROGRAMS OFFICE

The Plans and Programs Office plans, implements, and monitors execution of the AFHRL Research, Development, Testing and Evaluation (RDT&E) program. Staff members perform long-range planning that combines higher headquarters guidance, Air Force user requirements, and technological opportunities. This office publishes all planning documents and prepares budget submissions to higher headquarters. The Plans and Programs Office effects program implementation by processing financial and budgetary documents and monitors the progress of all support, contractual, and in-house RDT&E efforts. Finally, the Office provides the resource management required to execute effectively the RDT&E program.

The Director of Plans and Programs is responsible to the AFHRL Commander for the proper operations of the Plans and Programs Office and bears staff responsibility for the Laboratory Headquarters' mission in plans and documentation, operations, programs, and financial management. The Director serves as a member of the CPG and the CPGEC.

Dr. Herbert J. Clark
Director

Dr. Robert A. Bottenberg
Director

ANALYSIS AND EVALUATION OFFICE

The Analysis and Evaluation Office performs operational analyses; evaluates proposed new efforts and advises the Commander and Division chiefs regarding mission compatibility and resource adequacy. The office provides guidance for economic and cost-analysis policies, and certifies cost-effectiveness analyses of equipment and facility utilization plans. The Analysis and Evaluation Office develops and evaluates impact-analysis and resources-allocation methodologies. Finally, this staff office assists Division chiefs and advises the Commander on the Divisions' R&D thrusts and architectures and conducts such special studies as are assigned by the Laboratory Commander.

The Director of Analysis and Evaluation is responsible to the AFHRL Commander for the proper operations of the Analysis and Evaluation Office and bears staff responsibility for the Laboratory Headquarters' mission in analysis and evaluation of planned and ongoing RDT&E. The Director serves as a member of the Corporate Planning Group and of the Corporate Planning Group Executive Committee.

Colonel William C. DeBoe
Director

APPLICATIONS AND LIAISON OFFICE

The Applications and Liaison Office is charged with facilitating the introduction of RDT&E end products into operational use. Such efforts are directed toward improving the relationship between researchers, sponsors, and users of end products by encouraging closer coordination from the initial determination of a problem through the implementation of a product. The Office manages the RDT&E utilization tracking program which assesses the degree of user satisfaction with Laboratory products. The Applications and Liaison staff evaluate Independent Research and Development (IR&D) technical plans of private industry, collect external evaluations, and conduct on-site project evaluations of IR&D performed at AFHRL designated firms.

The Applications and Liaison staff advise the Laboratory Commander and inform Division Chiefs on user acceptability and implementation of RDT&E end products. Further, the staff conducts follow-up analyses of Laboratory RDT&E with user groups to assess specific successes, failures and lessons learned. Public Law 96-40 mandates that the office track and report on all AFHRL projects that could have an impact on civilian R&D. Finally, the office publicizes the Laboratory research program, specifically through publication of an annual report, newsletters, and informational flyers and brochures.

The Director of Applications and Liaison is responsible to the Laboratory Commander for the proper operations of the office and bears staff responsibility for the Laboratory Headquarters' mission in RDT&E applications and liaison. The Director serves as a member of the CPG and the CPGEC.

AFHRL RESEARCH AND SUPPORT DIVISIONS

Colonel Donald C. Tetmeyer
Division Chief

LOGISTICS AND TECHNICAL TRAINING DIVISION

The Logistics and Technical Training Division is responsible for research and development in the following areas: management science aspects of logistics systems functions; individual and technical training including the design and utilization of simulators and training devices for such training; and crew, group, team, and unit performance in the operation of command and control, missile, and space systems exclusive of flying vehicle operation. Division personnel provide consultation to Air Force and other Department of Defense agencies in their areas of responsibility.

In Weapon Systems Logistics, efforts are concentrated in three areas. The Acquisition Logistics area includes R&D to improve tools and techniques for incorporating logistics factors into the design, development, evaluation, and life cycle costing of Air Force weapon systems. The goal is the development of a technology that will permit the acquisition of systems which can meet program system readiness objectives within established manpower and logistics constraints. The maintenance performance area includes research and development programs to improve the effectiveness and efficiency of personnel and organizations responsible for the maintenance of Air Force weapons systems and support equipment. Programs involve the development of improved techniques in the areas of training, job aiding, maintenance management, maintenance policies and procedures, and organizational structure. The logistics functions area involves R&D on techniques for designing and managing logistics functions and systems to meet peacetime readiness and wartime employment objectives.

The Technical and Maintenance Training thrust includes efforts that are devoted to developing, demonstrating, and evaluating improved concepts, methods, media, and systems for technical training. Special attention is given to R&D aimed at defining the optimum use of computers in various types of instructional systems. A major area of emphasis is the development and evaluation of simulators to support maintenance training. The development and evaluation of instructional and management techniques to improve the cost effectiveness of on-the-job training is another area of major effort.

The Crew, Group, Team, and Unit Performance and Training thrust involves R&D aimed at developing techniques, methods and devices for evaluating and improving the performance of teams, crews, and units who operate/control ground-based systems. Special emphasis is given to R&D in the Command, Control, and Communications area for the development and demonstration of performance measurement techniques applicable to ground operator teams and crews. The R&D will also determine the impact on performance of such factors as personnel policies, training, operational procedures, environmental factors, and organizational policies.

MANPOWER AND PERSONNEL DIVISION

With the anticipated decline in the service-eligible population during the 1980s, one of the major problems facing the Air Force today is manning. To alleviate this projected manpower shortage, the Manpower and Personnel Division plans to initiate a research program designed to improve ways to attract the most qualified individuals, optimally assign them where they will be most productive, and retain a sufficient number in the career force to meet operational requirements.

To support the Division's major thrust area, i.e., manpower and force management, research is conducted to develop management tools, procedures and associated technologies to improve procurement, selection, classification, utilization, productivity, and retention of Air Force personnel. Results of this research provide a substantive basis for personnel decisions in all phases of the military life cycle to maximize the utilization of talent and to insure that manpower resources are allocated to maximize the return of personnel investment.

Matching the right person with the right job requires job analysis and individual qualification assessment. Ongoing research includes the development of aptitude and interest measures; methods for collecting, analyzing and modeling occupational information; and establishing physical, aptitude, experience, and education requirements for specific jobs. The Division also meets research and development requirements for the Armed Services Vocational Aptitude Battery to support Air Force single managership of the tri-service battery.

Dr. Nancy Guinn
Technical Director

Colonel Tyree H. Newton
Division Chief

The Division has developed a computer-based person-job match system that has been operationally integrated in the Air Force Recruiting Service Procurement Management Information System. This system computes applicants' best job options by comparing their interests and abilities with those of their contemporaries and Air Force needs. Recruiters indicate that the system, in matching the applicants' abilities and interests and the Air Force needs, virtually guarantees placing "the right person in the right job."

In order to maintain sufficient quantity and quality of personnel in the career force, the Division is also conducting studies to improve personnel utilization, job satisfaction, productivity, workgroup effectiveness, and career motivation. In addition, efforts toward the development of measures of job performance have led to the development of a performance appraisal system for Air Force civilian personnel.

Colonel Richard C. Needham
Division Chief

Responsibility for research and development in flying training technology for the Air Force Human Resources Laboratory resides with the Operations Training Division. This Division develops, tests, and evaluates existing and newly developed hardware, programs, procedures, and techniques for improving all phases of flying training programs. The Division is collocated with the Air Training Command (ATC) at Williams AFB, Arizona, and has an operating location at Luke AFB, Arizona, with the Tactical Air Command (TAC). The Division facilities are accessible to the Air Force flying commands (ATC, TAC, Military Airlift Command, and Strategic Air Command) and serve the Navy and Army as well. The close proximity to the Gila Bend Gunnery Range, Tactical Fighter Weapons Center, and Air Force Flight Test Center enhances its interface with the operational community.

The Operations Training Division conducts studies to exploit simulator capabilities for improving pilot training.

Originally configured with two T-37 cockpits, the simulator system has been completely rebuilt to simulate the A-10 and F-16 aircraft. These aircraft enable the Division to conduct research in a broad spectrum of areas of interest to the tactical fighter community. These include defining simulation equipment and techniques which may lead to improved training transfer and better operational simulators. In addition, since the simulator is configured with front line fighter/attack aircraft, additional research in evaluating the utility of future aircraft modifications and unique sensor components can be conducted.

The Division is conducting research in flying skills maintenance and reacquisition, low-level navigation, air-to-air refueling requirements, air combat maneuvering, air-to-ground continuation training, crew coordination, operational test and evaluation, and A-10 and F-16 syllabus effectiveness. Research efforts also include simulator visual and force cue requirements and advanced simulator hardware systems. The Division is available to assist aircraft accident investigation boards in simulating conditions prior to an accident so board findings may be more accurate and meaningful to accident prevention.

The Division has initiated research efforts to investigate pilot performance in simulated hostile high threat environments. Research efforts to date include determining pilot performance in hostile situations, impacts of programmed threat proficiency, chaff, and Electronic Countermeasures protection. Refinement of these simulation efforts will have a major impact on increasing Air Force readiness by improving training for hostile flight regimes in the high threat environment.

Dr. Marty R. Rockway
Technical Director

TECHNICAL SERVICES DIVISION

The Technical Services Division plans, allocates, and controls facility and manpower resources. The Division directs the scientific and technical information program, including the technical library, to meet the information needs of scientific and technical personnel in managing, monitoring, and conducting Research and Development (R&D). Further, the Division provides a full range of technical editorial services, plans and directs the recording of the corporate history, provides staff administrative services, and serves as the focal point with supporting organizations. The Division develops data bases, maintains data files, and operates the computer system to support the Research, Development, Test, and Evaluation activities of the Laboratory; and provides project analysis and computer programming support to the other Divisions of the Air Force Human Resources Laboratory.

Lt Col Wendell Anderson
Division Chief

The Chief of the Technical Services Division is responsible to the Laboratory Commander for the proper operations of the Division and serves as a member of the Corporate Planning Group and of the Corporate Planning Group Executive Committee.

The functions of the organization elements within the Technical Services Division are as follows:

a. The Technical Editing Office serves as the focal point for publication of the results of R&D projects and performs technical editing, copy editing, and final composition of reports, journal articles, professional papers, brochures, and other documents. The office provides guidance to authors and contract monitors to ensure that technical reports comply with government regulations and professional standards. Further, the office staff composes the camera-ready final copy of reports, tests, survey forms, questionnaires, and brochures; maintains liaison with the Public Affairs Office to obtain clearance of technical reports for public release; coordinates printing requirements; and makes distribution of technical reports and TRACE (a 1,000-word summary of a technical report).

b. The Scientific and Technical Information (STINFO) Office plans and directs the STINFO program, including the Technical Library, to meet the information needs of scientific and technical personnel in managing, monitoring, and conducting R&D. The STINFO Office plans and directs the recording of the corporate history and develops and maintains contract data management policies and procedures. The STINFO Office implements Air Force foreign disclosure policies and procedures and arranges for authorized release of military information to foreign governments and foreign nationals and maintains close liaison with foreign technology personnel to ensure that foreign research results are available to Laboratory personnel. Further, the office serves as the focal point for small business and potential contractor programs, patents/inventions/copyrights, overseas travel, and security and policy review.

c. The Administration Office develops and implements policies, procedures, and standards relating to administration management and practices, military and civilian personnel and manpower actions, and materiel actions. The office provides staff guidance, assistance and surveillance over other echelons in areas of functional responsibility for the Laboratory Commander. The office

staff evaluates administration, personnel, and materiel procedures in other functional areas within the Laboratory and operates the following programs: manpower and organization, forms, publications and reports management, document security, military and civilian personnel administration (including training programs), organizational supply, and graphics support. Further, the Administration Office is the principal focal point for host-tenant support agreements for the Laboratory and off-base Divisions; represents the Laboratory in dealings with other agencies and higher headquarters in all areas of functional responsibilities; and serves as focal point for Inspector General visits and reports.

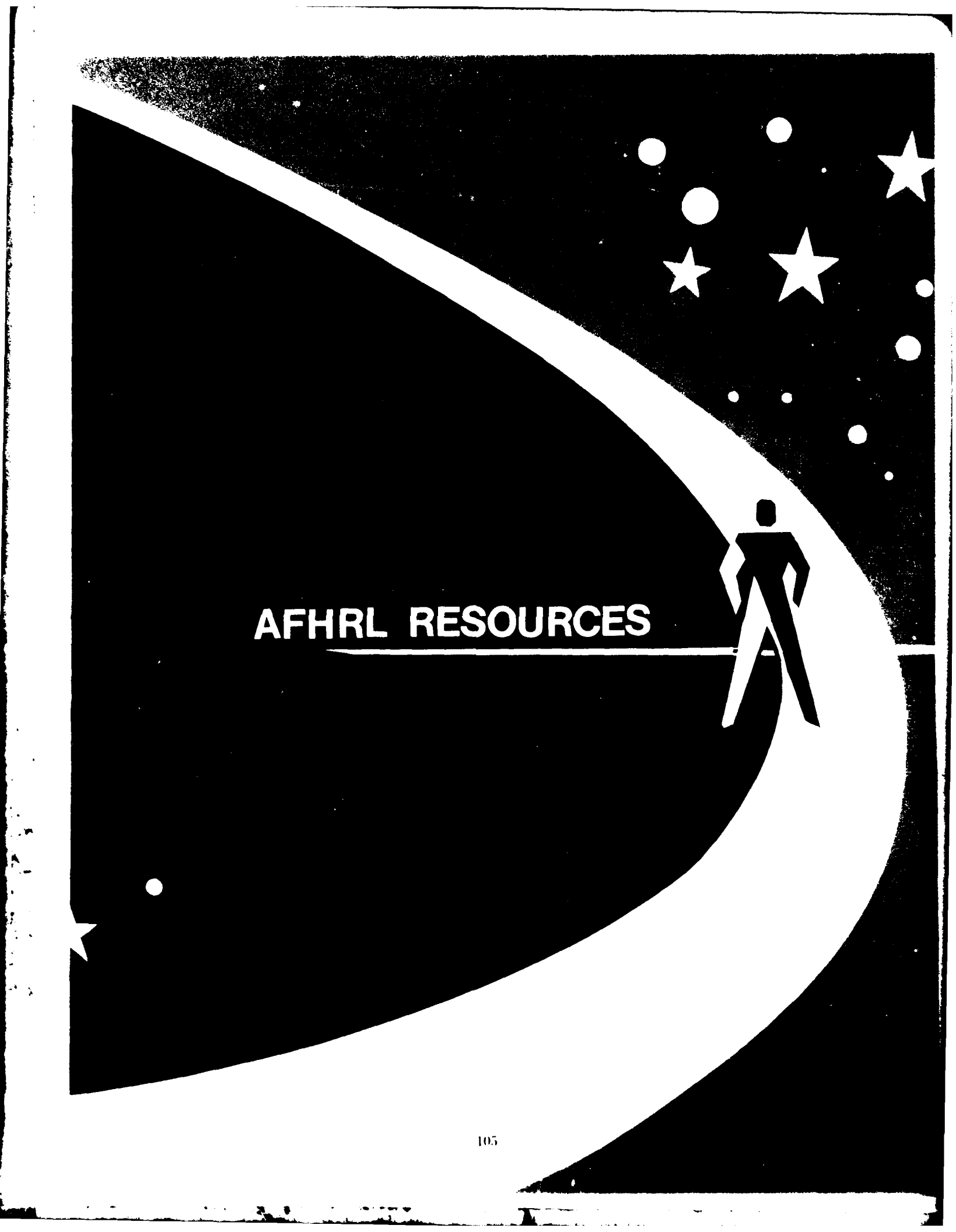
d. The Computer Operations Branch operates a large-scale multiprocessor computer facility, including peripheral equipment for support of the Laboratory research programs. The Branch maintains systems programming packages and a magnetic tape storage facility which operates a high-volume data preparation activity. The Branch staff ensures adequacy and accuracy of computer products through quality control and audit procedures.

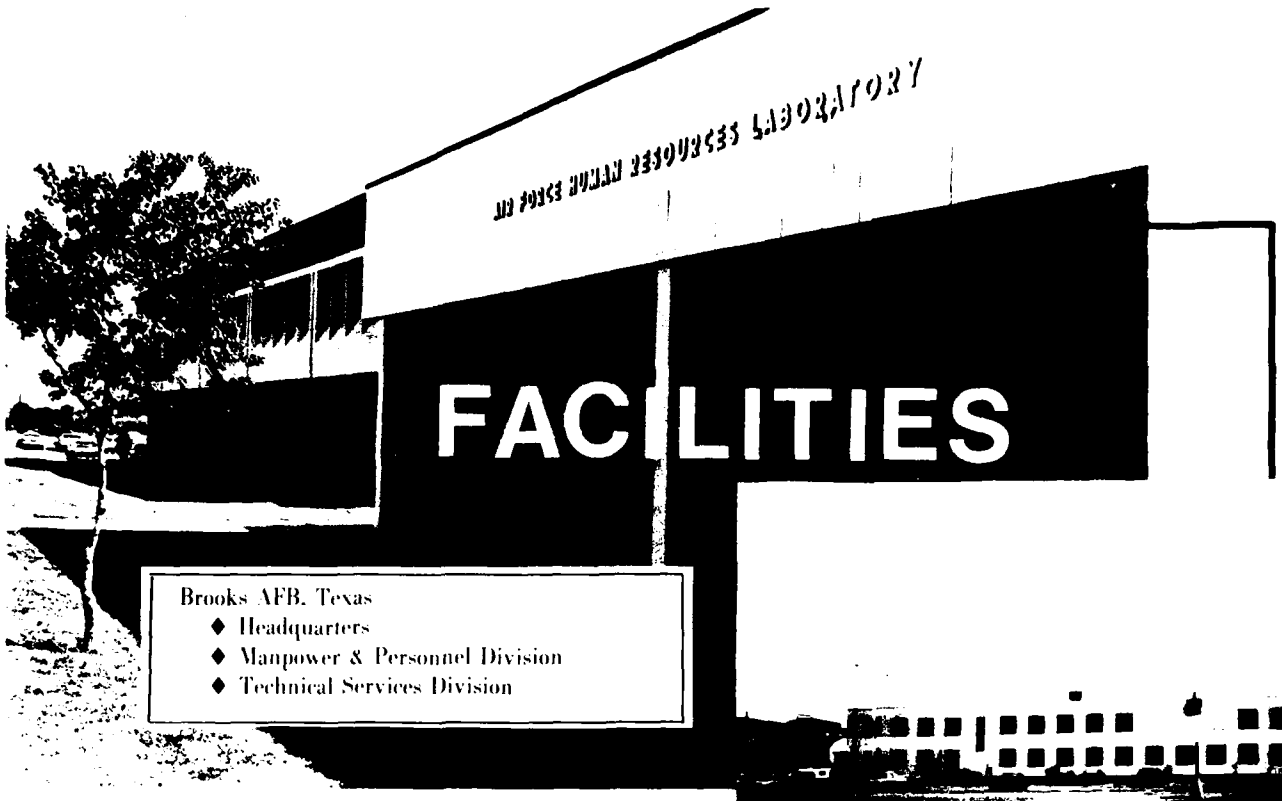
e. The Computer Programming Branch performs analyses of work requests from the task scientists and prepares systems flow charts and special purpose computer programs to fulfill the data processing and computational end product requirements for research psychologists. The Branch develops general purpose statistical and data processing programs for use by applications programmers in accomplishing work requirements from research personnel. The Branch staff provides consultative services and performs special studies in response to requests from agencies, develops and maintains files of research data from magnetic tape and other media, and provides summary reports from the data files.

f. The Management Information Center is responsible for the design, development, and operation of information systems to support the Laboratory Operations Center and the Command Management Information System. These systems include MASIS, JOCAS, JAMIS, INFOCEN, and data bases that support financial, budgetary, personnel, manpower, and planning. The Center directs the integration of data and office automation processing capabilities and systems and develops plans, policies, concepts, and procedures to ensure effective and efficient use of in-house and contractual computer resources. Further, the Center ensures compliance with all automatic data processing and acquisition regulations and conducts management audits of computer facilities to ensure compliance. Finally, the Center represents the Laboratory in all computer system matters and reviews and makes recommendations concerning automatic data processing requirements.


U.S. AIR FORCE

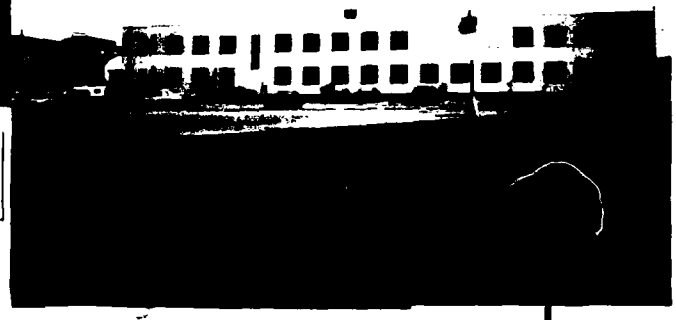

SAF
3667


AFHRL RESOURCES



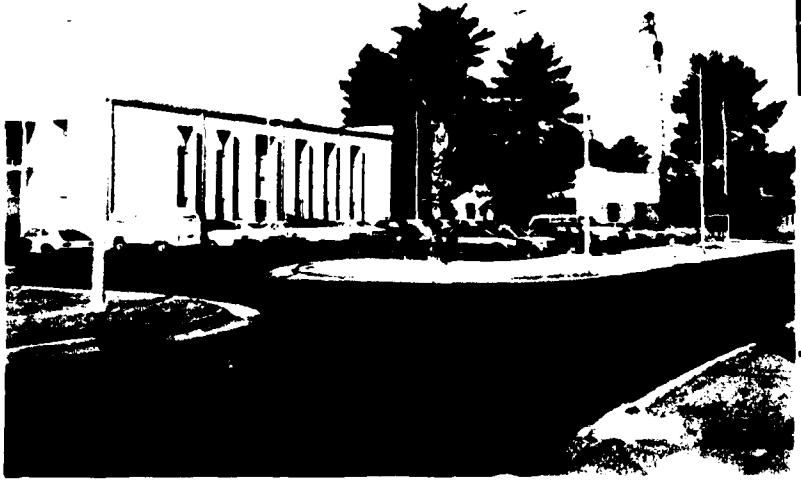
FACILITIES

Brooks AFB, Texas
- Headquarters
- Manpower & Personnel Division
- Technical Services Division



Wright-Patterson AFB, Ohio
- Logistics & Technical Training Division

Lowry AFB, Colorado
- Technical Training Branch



Williams AFB, Arizona
- Operations Training Division

The Technical Services Division of AFHRL maintains a general purpose Univac 1108 computer system to support research and development programs. Programs include extensive personnel research at AFHRL, medical research at the School of Aerospace Medicine, both headquartered at Brooks AFB, and occupational measurement by the Occupational Measurement Center at Randolph AFB.

The Univac 1108 system includes a 3072 square foot computer room, and a 2058 square foot tape library which houses between 15 and 20 thousand active tape files. The tape library is a historical data base of Air Force personnel files dating back to the mid-forties. It contains 37 unique data files, the largest of which is the Airmen Reenlistment and Loss file that contains approximately four million records dating from 1955 to 1979.

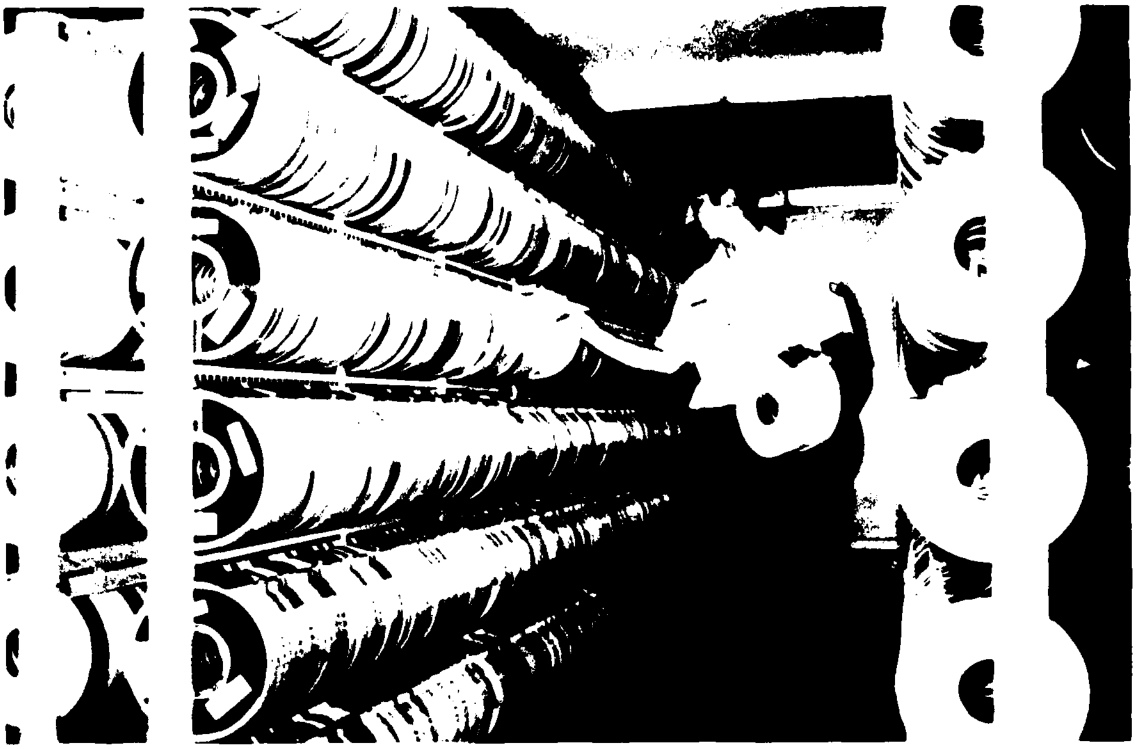
The computer hardware itself is designed to accept data tapes written in all standard formats. This allows the laboratory to accept data collected by other organizations on their computer systems. It also permits AFHRL to prepare tapes in formats acceptable to other organizations. The 1108 system supports all major programming languages to include FORTRAN, COBOL and System 2000 which have the heaviest usages. Over 300 people are authorized use of the U 1108 through a variety of access routes. Means of access include dial-up telephone lines, dedicated telephone lines (these service Luke and Williams AFBs, Randolph AFB, as well as AFHRL contractors and the School of Aerospace Medicine at Brooks AFB) and directly connected terminals (32 at AFHRL).

In addition to the central computing facility at Brooks AFB, AFHRL has computer resources at Williams AFB, Lowry AFB and Wright-Patterson AFB. The Automated Data Processing Equipment (ADPE) at Williams AFB consists of nine Systems Engineering Laboratory (SEL) 32/75 computers, three SEL 8600 computers, one SEL 7200 computer, a Univac 100 terminal system consisting of two CRT terminals and a printer, a Univac 700 remote batch terminal and a Univac 200 terminal and printer. The ADPE at Williams is used to support the Advanced Simulator for Pilot Training (ASPT), which is used in support of the primary mission of AFHRL/Operational Training Division.

Located at Lowry AFB is a Control Data Corporation CYBER 73-16. This system provides support for Computer Managed Instruction (CMI) and Computer Assisted Instruction (CAI) for three operational Air Training Command courses. The system is used as a research tool for the development and evaluation of computer-based education and training.

A Digital Equipment Corporation (DEC) POP 11/20 also at Lowry AFB currently supports software and instructional material development for maintenance training simulation utilizing microprocessors. The system is interfaced to the CYBER 73-16 and the PLATO IV Systems to provide graphic hard copy capability for either system.

Located at Wright-Patterson AFB is a DEC POP 11/45 System which supports an R&D project for ground operations training. The objective is to reduce training time and improve performance of weapons directors in missile and space command and control systems. The project will utilize a special purpose high resolution, color roster scan "3D" graphics display system.





LABORATORY OPERATIONS CENTER

The Laboratory Operations Center (LOC) was established as a test bed for exploring the feasibility of combining word processing and data base management in the same system. The LOC is the focal point for collecting, and controlling data used in the management of the AFHRL technical program. Using the Generalized Data Base Management System, System 2000, the LOC has established a Management Information System, reflecting status and resources data for work units in the Laboratory research and technology program. Data can be retrieved from the data base by any AFHRL personnel. Various kinds of output can be provided, including color graphic displays suitable for projection. In addition to the operational requirements, the LOC is developing the software to enable the AFHRL Product Divisions to update the data base directly using the Wang 2200VS terminals and retrieve data as desired through the Wang terminals or any data processing terminal.

AFHRL LIBRARY FACILITIES

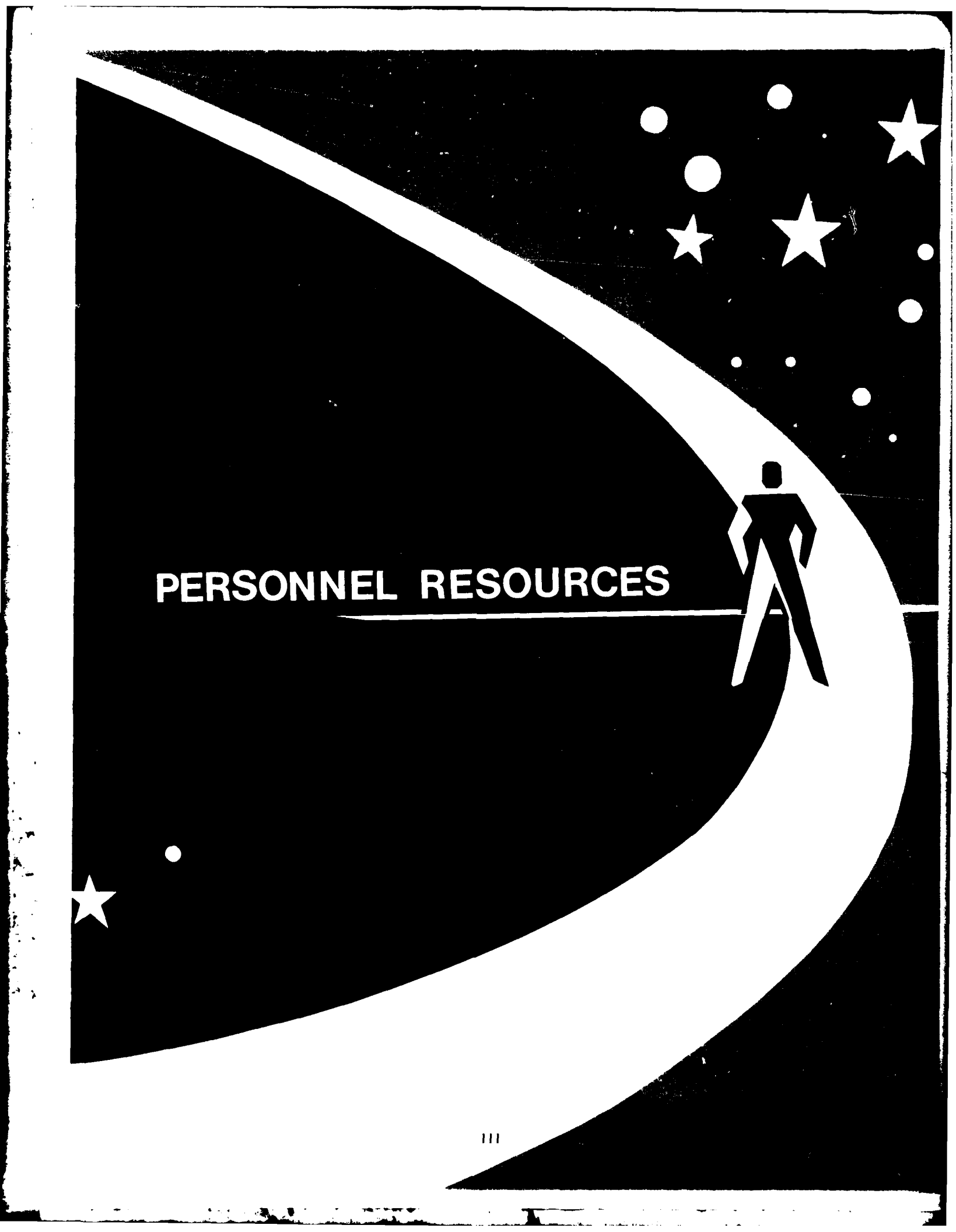
The AFHRL Library provides services for the Headquarters, Staff Offices and Divisions on Brooks AFB and those Divisions and offices located in other geographical areas. These services include the acquisition of books, journals, and other library materials and on-line access to the Information Central System (INFOCEN) at Wright-Patterson AFB and to the more than 100 data bases included in the Lockheed Information Systems, DIALOG Information Retrieval Services at Palo Alto, California.

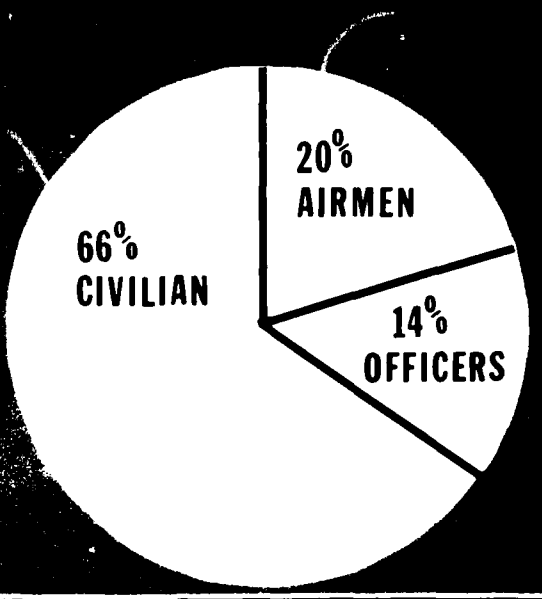
A special summer project resulted in the cataloging of 711 technical reports. These reports were publications of AFHRL, of similar laboratories in the Army and Navy plus those of other governmental agencies, and of universities and corporations performing behavioral science research.

The Library began implementation of the policy to discontinue binding journals available on 16mm microfilm and continued its policy to acquire backfiles for journals in the collection and to convert backfiles to microfilm. There are three microform reader/printers available for the use of that collection.

The Library participates in two consortia — the San Antonio Area Online Users Group (SOLUG) and the Health Oriented Libraries of San Antonio (HOLSA). A project to include the journal holdings of this library in the HOLSA union list of serials was initiated.

At the conclusion of FY 80, Library holdings were 13,030 books and bound journals; 11,011 technical reports, of which 2,668 are on microfiche; and 378 journal subscriptions. The office collection at the Logistics and Technical Training Division (LR), Wright-Patterson AFB, consisted of 297 books. The Technical Training Branch (LRT), Lowry AFB, had 234 books and 49 journal subscriptions. The collection at the Operations Training Division (OT), Williams AFB, included 377 books and 31 journal subscriptions.

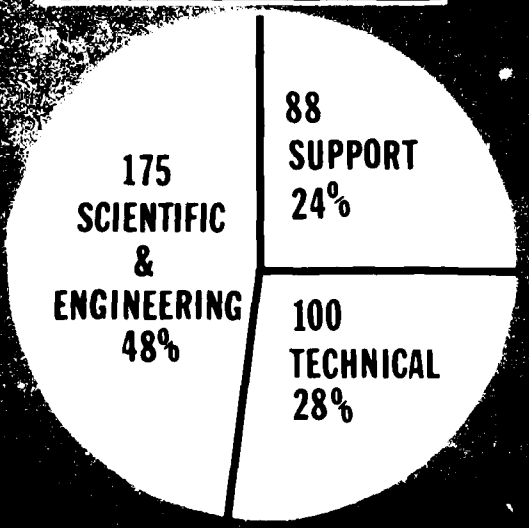

PERSONNEL RESOURCES



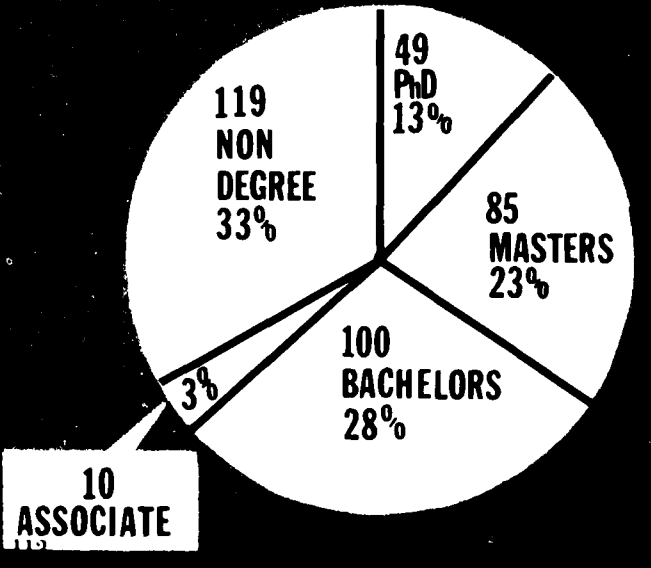
DISTRIBUTION OF AUTHORIZED PERSONNEL FY 80

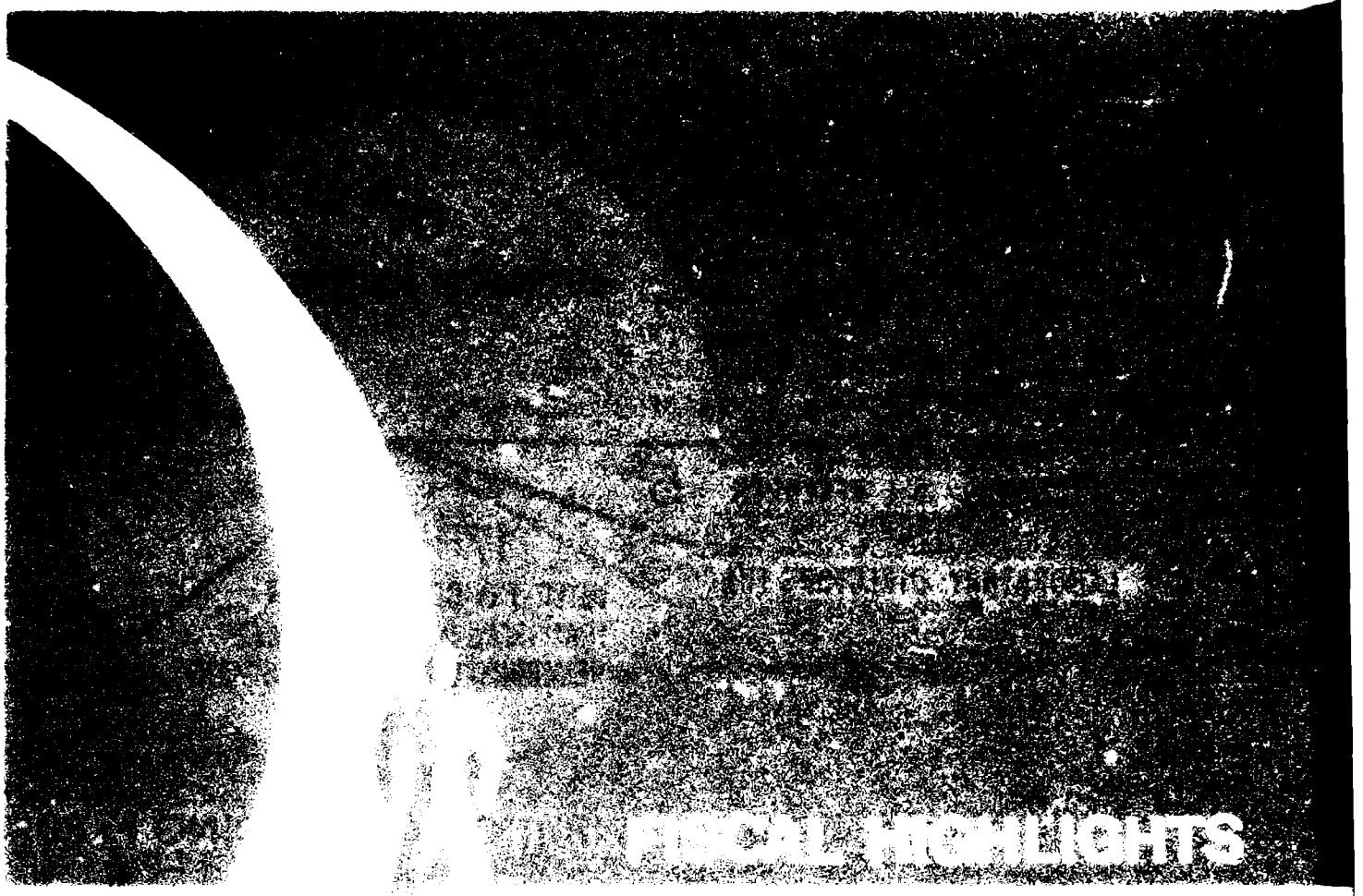
AUTH PERSONNEL	FY 80
OFFICERS	52
AIRMEN	73
CIVILIANS	238
TOTAL	363

PERSONNEL TYPE



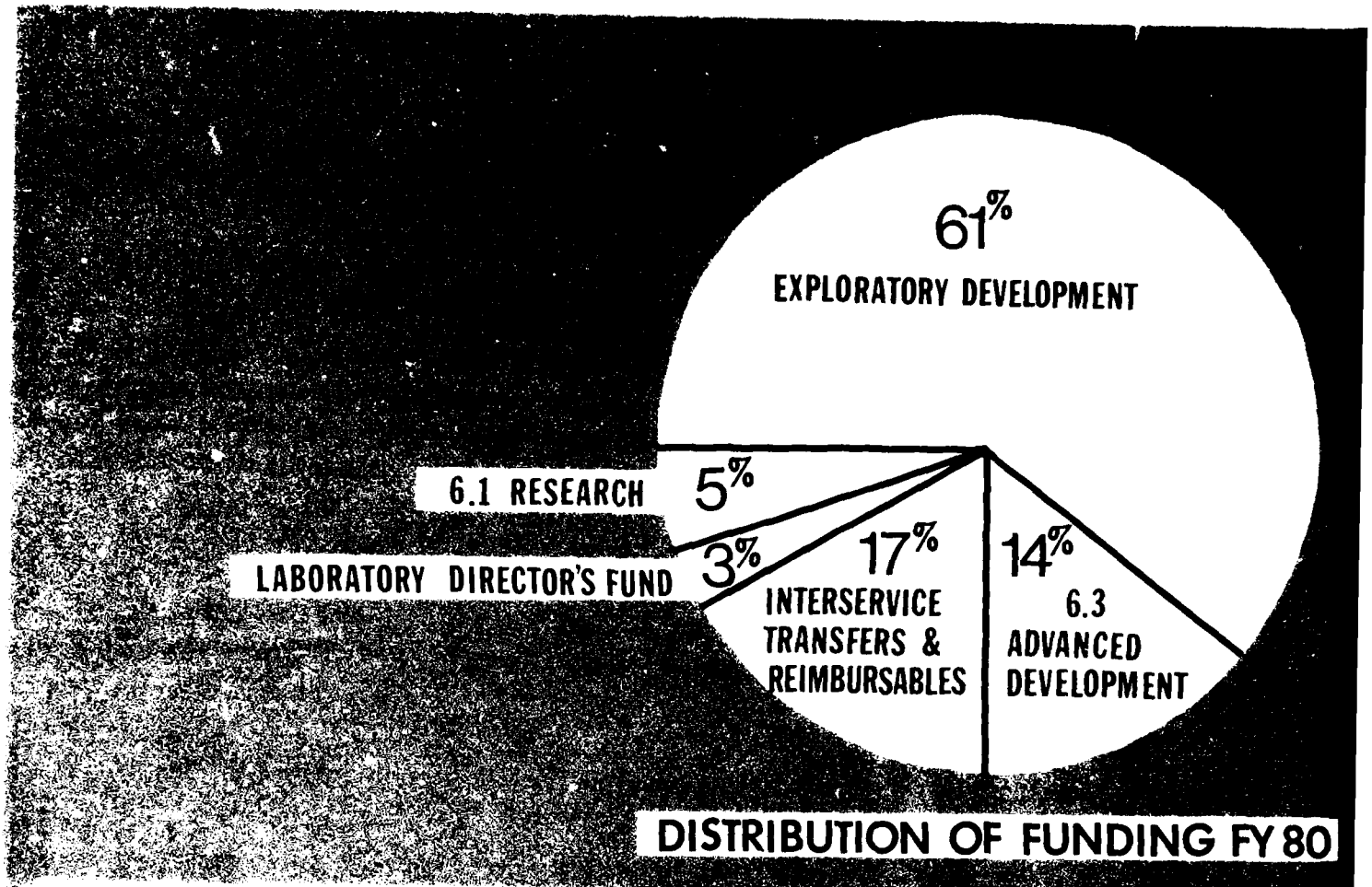
ACADEMIC DEGREES



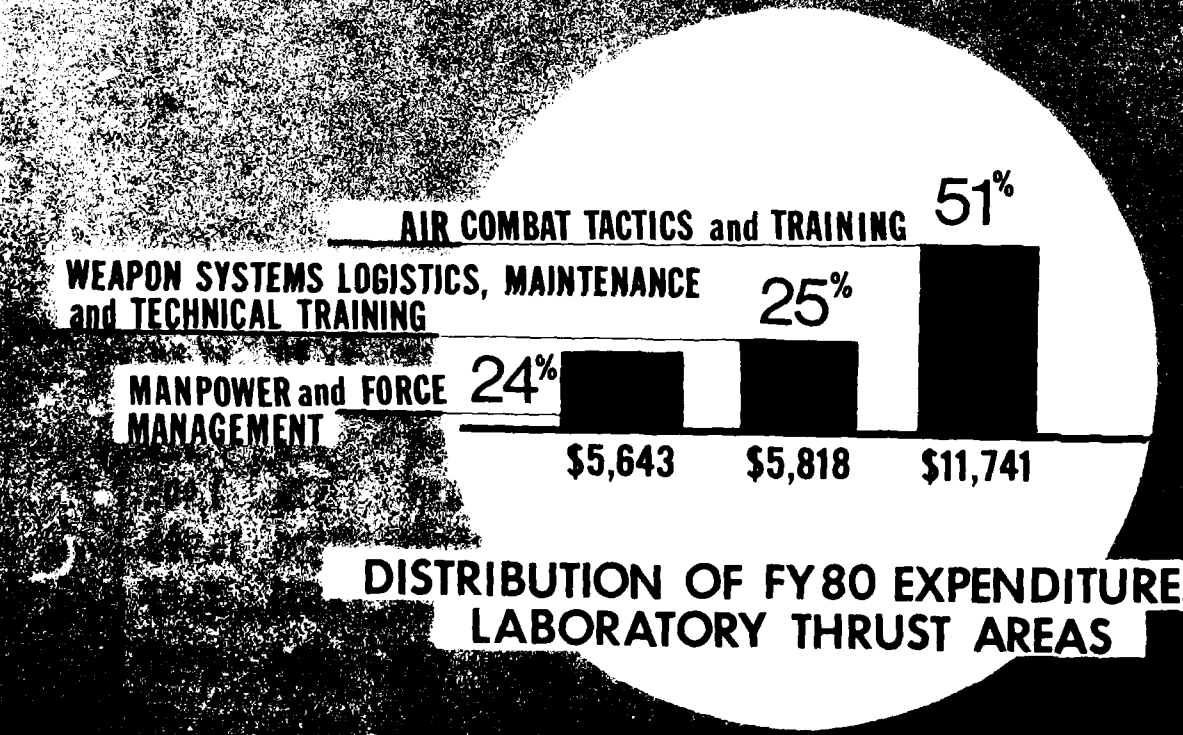


FUNDING SUMMARY ($1000)

	FY 77	FY 7T	FY 78	FY 79	FY 80
LABORATORY DIRECTOR'S FUND	$ 405	105	450	720	720
RESEARCH (6.1)	556	26	429	575	1,405
EXPLORATORY DEVELOPMENT (6.2)	8855	2117	10,865	15,504	15,390
ADVANCED DEVELOPMENT (6.3)	9,225	2,198	9,448	4,600	3567
INTERSERVICE TRANSFERS & REIMBURSABLES	1,619	2	953	2,095	4,210
TOTAL	20,660	4,448	22,145	23,494	25,292



DISTRIBUTION OF FUNDING FY 80



DISTRIBUTION OF FY 80 EXPENDITURES
LABORATORY THRUST AREAS

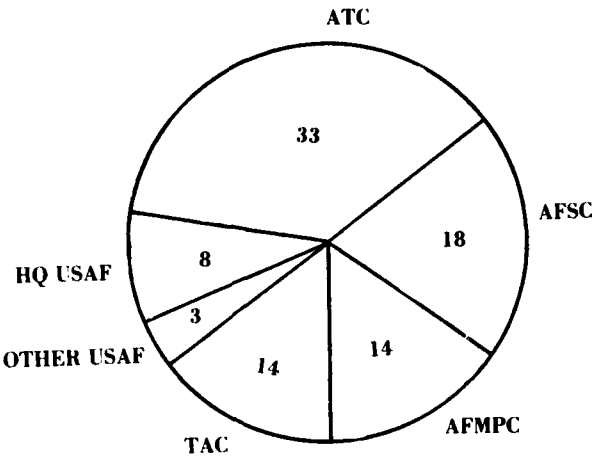
T^2

Technology transfer (T^2) is a major effort of the Applications and Liaison Office of AFHRL. Technology transfer is the process through which the Laboratory ensures that R&D products find their way to users who will apply the results of R&D efforts. The Laboratory has developed formal processes which continually monitor, evaluate, measure, and feed back to the Laboratory the impact of all R&D products, including basic and applied research.

The main objective of the Laboratory is to develop R&D products that impact the primary mission of the Air Force. For a one-year period, AFHRL delivered 90 R&D products to Air Force customers.

After the Air Force user receives the AFHRL R&D product, the user is required to determine the value of the research to the organization. That is, the user evaluates the timeliness, the completeness, the clarity, the relevance of the findings, the implementation feasibility, and the overall impact of the research on the Air Force. The results of the evaluations are used by AFHRL to judge the overall value of the AFHRL R&D efforts and to make adjustments to ongoing programs, if appropriate. It has been found that Air Force users are about 90% satisfied with Laboratory R&D efforts, a very high percentage for any R&D program. However, the Laboratory is constantly striving to increase user satisfaction with R&D products.

Research and development is a dynamic process, constantly adjusting to changing environments. Air Force needs are identified years before actual R&D products are delivered. A few typical examples of outstanding AFHRL research products which significantly impacted Air Force operational capabilities within recent years include: (1) The Advanced Simulator for Undergraduate Pilot Training (ASUPT) which led to the development of full visual Combat Training Simulators, such as the F-16 and A-10; (2) the Logistics Composite Model (LCOM) which provided a methodology for realistically determining maintenance and manpower requirements on new weapon systems; (3) the Person-Job-Match (PJM) system that enabled the Air Force to optimally distribute present and projected manpower resources to best match operational requirements; and (4) the Weighted Airman Promotion System (WAPS) which led to the establishment of an equitable promotion policy for AF enlisted personnel.



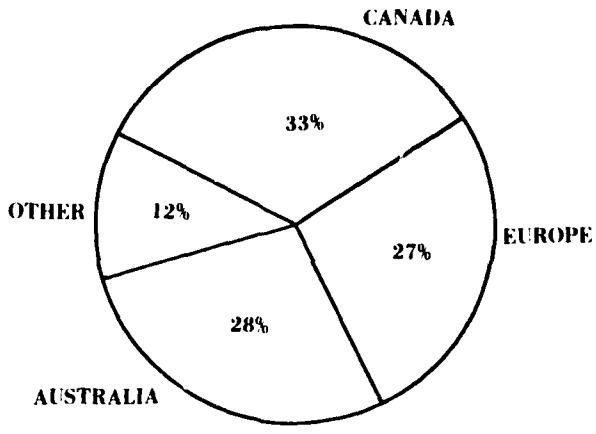
90 R&D PRODUCTS DELIVERED TO AIR FORCE CUSTOMERS

The Applications and Liaison Office has also developed sophisticated algorithms to track internal utilization of R&D products by the Laboratory. That is, the Laboratory is able to track AFHRL research projects over many years and generations of research to determine which combined research efforts led to a successful R&D product.

The Applications and Liaison Office receives, on a regular basis, detailed sales information of AFHRL technical reports from computers at the Defense Technical Information Center (DTIC) and from the Department of Commerce's National Technical Information Service (NTIS). From this information, it has been determined that over 8,000 AFHRL technical reports have been used by various categories of customers. These users are then queried as to the impact of the AFHRL technical reports on their organizations.

GROUPS REQUESTING REPRINTS OF OVER 8,000 AFHRL TECHNICAL REPORTS FROM NTIS AND DTIC

CATEGORY OF REQUESTOR	% OF TOTAL REQUESTS	
	NTIS	DTIC
PRIVATE INDUSTRY	35.69	11.88
PRIVATE INDUSTRIAL LIBRARIES	29.75	17.42
UNIVERSITIES	7.63	3.40
FOREIGN GOVERNMENTS	7.58	0
MILITARY (ARMY, USAF, NAVY)	4.29	26.59
OTHER GOVERNMENT AGENCIES	4.07	3.55
MILITARY LIBRARIES (ARMY, USAF, NAVY)	3.35	35.09
OTHER	7.64	2.07



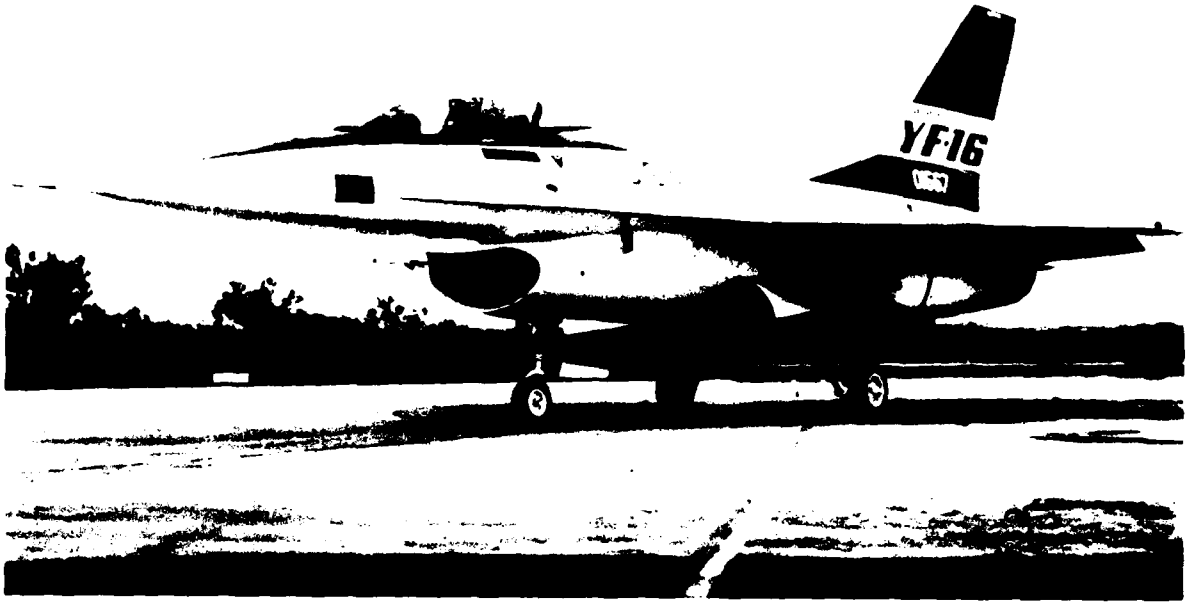
FOREIGN DISTRIBUTION OF 80 AFHRL TECHNICAL REPORTS FOR A ONE YEAR PERIOD

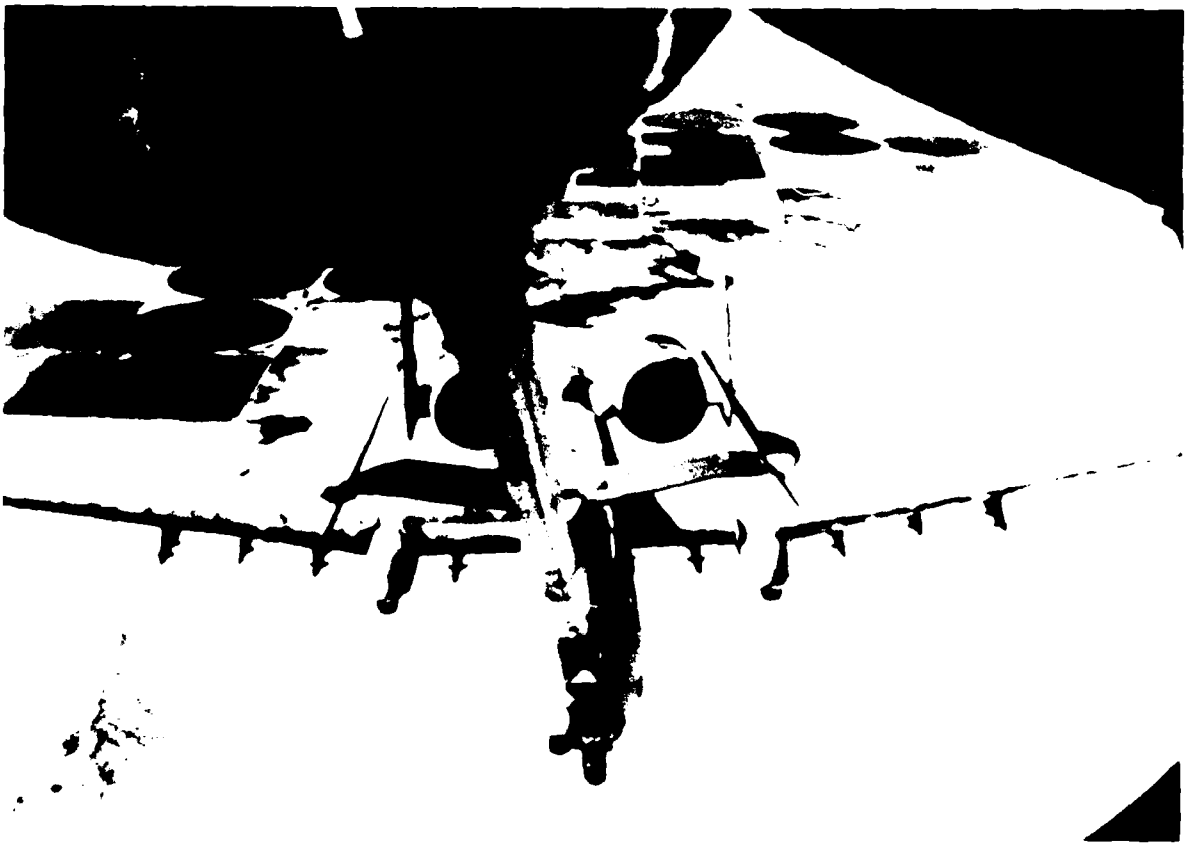
Another measure of AFHRL technology transfer is the degree of utilization of AFHRL technical reports by foreign sources (government and private industry). The Applications and Liaison Office has been tracking foreign users since 1976 and the results are rather constant for each year, i.e., about 80 AFHRL technical reports per year are requested by foreign sources.

The Applications and Liaison Office also tracks the utilization of AFHRL technical reports, professional papers, and publications in the world's most important professional journals.

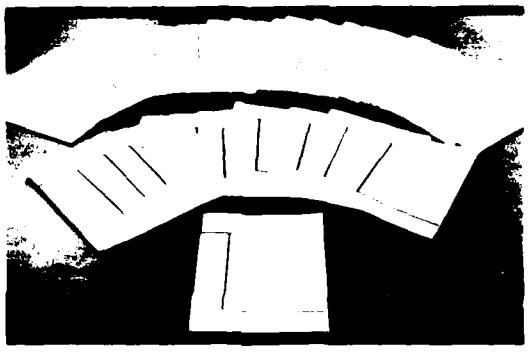
When Congress passed PL 96-480 in 1980 requiring Federal laboratories to track, measure, and report on the technology transfer of Federal laboratory R&D efforts to the civilian community, AFHRL already had in place and operating a complete technology transfer program which met the requirements of the law. AFHRL's technology transfer program has been requested by other Federal laboratories and by Headquarters AFSC for their consideration in meeting the requirements of PL 96-480.

The Laboratory views technology transfer as a vital dynamic process in which the results of all the tracking utilization programs are used to improve ongoing R&D projects and to maximize the planning of proposed projects.


YF-16



DOCUMENTATION AND PRESENTATIONS FY 80



UNCLASSIFIED TECHNICAL REPORTS DISTRIBUTED IN FY 80

Albert, W.G. *Computerized algorithms: Evaluation of capability to predict graduation from Air Force Training.* AFHRL-TR-80-6, AD-A091 105.

Albert, W.G. *Predicting involuntary separation of enlisted personnel.* AFHRL-TR-79-58, AD-A082 995.

Albert, W.G., & Whitehead, L.K. *IAPG: An item analysis program for questionnaire—type test instruments.* AFHRL-TR-80-5, AD-A089 814.

Ausburn, F.B., Ausburn, L.J., & Ragan, T.J. *Task analysis schema based on cognitive style and supplantational instructional design with application to an Air Force training course.* AFHRL-TR-79-59, AD-A082 342.

Bailey, J.S., & Hughes, R.G. *Applied behavior analysis in flying training research.* AFHRL-TR-79-38, AD-A081 750.

Bailey, J., Hughes, R.G., & Jones, W.E. *Application of backward chaining to air-to-surface weapons delivery training.* AFHRL-TR-79-63, AD-A085 610.

Barlow, E.M. *Annotated bibliography of the Air Force Human Resources Laboratory Technical Reports — 1978.* AFHRL-TR-80-1, AD-A087 065.

Buckland, G.H., Monroe E.G., & Mehrer, K.I. *Flight simulator runway visual textural cues for landing.* AFHRL-TR-79-81, AD-A089 434.

Cicchinelli, L.F. *Avionics maintenance training: Relative effectiveness of 6883 simulator and actual equipment test and evaluation plan.* AFHRL-TR-79-13, AD-A077 342.

Cooper, M., Imhoff, D.L., & Myers, D.C. *Introduction of women into work groups in traditionally male career fields: Annotated bibliography.* AFHRL-TR-80-22, AD-A087 067.

Dansereau, D.F., Holley, C.D., Collins, K.W., Brooks, L.W., McDonald, B., & Larson, D. *Validity of learning strategies/skills training.* AFHRL-TR-79-84, AD-A085 659.

Davis, J.D., Carson, S.B., & Reed, W.R. *Feasibility of computer applications to mission-oriented training in the aircraft armament systems specialist career field.* AFHRL-TR-79-61, AD-A081 446.

Dean, J., Overton, R., Miller, R., Lankford, H., & Hughes, R.G. *Specialized undergraduate pilot training: Tanker/transport/bomber (TTB) training requirements.* AFHRL-TR-80-9, AD-A088 730.

Deignan, G.M., Seager, B.R., Kimball, M., & Horowitz, N.S. *Computer-assisted, programmed text, and lecture modes of instruction in three medical training courses: Comparative evaluation.* AFHRL-TR-79-76, AD-A085 609.

DeMaio, J.C., & Eddowes, E.E. *Airborne performance measurement assessment: Low altitude tactical formation in two operating environments.* AFHRL-TR-79-44, AD-A087 068.

DeVries, P.B., Jr., Eschenbrenner, A.J., Jr., & Ruck, H.W. *Task analysis handbook.* AFHRL-TR-79-45(II), AD-A087 711.

Dobrovolny, J.L., McCombs, B.L., & Judd, W.A. *Study skills package: Development and evaluation.* AFHRL-TR-79-43, AD-A083 232.

Donahue, K.E., Medellin, A., & Loup, K. *Bibliography: Occupation and Manpower Research Division, Air Force Human Resources Laboratory (1957—1979).* AFHRL-TR-79-71, AD-A081 751.

Eckstrand, G.A. *Technology projection: Manpower and logistic factors in weapon system development.* AFHRL-TR-80-2, AD-A088 314.

Engler, H.F., Davenport, E.L., Green, J., & Sears, W.E., III. *Human operator control strategy model.* AFHRL-TR-79-60, AD-A084 695.

Eschenbrenner, A.J., Jr., DeVries, P.B., Jr., Miller, J.T., & Ruck, H.W. *Methods for collecting and analyzing task analysis data.* AFHRL-TR-79-45(I), AD-A087 710.

Fuller, J.H., Waag, W.L., & Martin, E.L. *Advanced simulator for pilot training: Design of automated performance measurement system.* AFHRL-TR-79-57, AD-A088 855.

Goclowski, J.C., Glasier, J.M., Kistler, R.H., Bristol, M.A., & Baran, H.A. *Digital avionics information system (DAIS): Life cycle cost impact modeling system reliability, maintainability, and cost model (RMCM) — Description Users Guide.* AFHRL-TR-79-65, AD-A089 045.

Goclowski, J.C., LoFaso, A.J., Peskoe, S.E., & Baran, H.A. *Air Force personnel availability analysis: A description of the personnel availability model (PAM).* AFHRL-TR-79-66, AD-A089 707.

Goclowski, J.C., Peskoe, S.E., LoFaso, A.J., & Baran, H.A. *Air Force personnel availability analysis: Application techniques of the personnel availability model (PAM).* AFHRL-TR-79-67, AD-A088 801.

Goclowski, J.C., LoFaso, A.J., Peskoe, S.E., & Baran, H.A. *Air Force personnel availability analysis: Program description for the personnel availability model (PAM).* AFHRL-TR-79-68, AD-A088 800.

Goett, J.M., Post, T.J., & Miller, G.G. *6883 maintenance training simulator development utilizing imagery techniques.* AFHRL-TR-80-3, AD-A088 315.

Gray, T.H. *Boom operator part-task trainer: Test and evaluation of the transfer of training.* AFHRL-TR-79-37, AD-A079 796.

Harker, G.S., & Jones, P.D. *Depth perception in visual simulation.* AFHRL-TR-80-19, AD-A087 828.

Hendrix, W.H. *Organizational assessment indices of effectiveness.* AFHRL-TR-79-46, AD-A081 073.

HQ Air Force Human Resources Laboratory (AFSC). *19th annual conference of the military testing association.* AFHRL-TR-79-78, AD-A077 347.

Hritz, R.J., & Purifoy, G.R., Jr. *Maintenance training simulator design and acquisition.* AFHRL-TR-80-23, AD-A089 149.

Hughes, R.G., Hannan, S.T., & Jones, W.E. *Application of flight simulator record/playback feature.* AFHRL-TR-79-52, AD-A081 752.

Kalisch, S.J., Jr. *Computerized instructional adaptive testing model: Formulation and validation.* AFHRL-TR-79-33, AD-A081 855.

King, G.F., & Askren, W.B. *Human resources, logistics, and cost factors in weapon system development: Project summary.* AFHRL-TR-80-8, AD-A089 708.

Kleinwaks, J.M. *Advanced low cost g-cuing system (ALCOGS).* AFHRL-TR-79-62, AD-A079 809.

Kraft, C.L., & Anderson, C.D. *Psychophysical criteria for visual simulation systems: Phase II—Experimental investigations of display joints and scene inserts.* AFHRL-TR-80-18, AD-A088 316.

Krahenbuhl, G.S., Darst, P.W., Marett, J.R., Reuther, L.C., Constable, S.H., & Reid, G.B. *Undergraduate pilot training: Instructor pilot behavior and student stress and performance.* AFHRL-TR-80-15, AD-A088 802.

Krahenbuhl, G.S., Marett, J.R., Reuther, L.C., Constable, S.H., & Reid, G.B. *Pilot stress in A-10 surface-attack training.* AFHRL-TR-80-16, AD-A088 803.

Lewis, W.E., Lovelace, D.E., Mahany, R.W., & Judd, W.A. *Computer-assisted instruction in the context of the advanced instructional system: Materials development procedures and system evaluation.* AFHRL-TR-79-74, AD-A082 996.

Lindholm, E., Ruppel, M., & Buckland, G.H. *Attention and task complexity as indicated by physiological indices.* AFHRL-TR-79-47, AD-A080 851.

Lintz, L.M., Pennell, R., & Yasutake, J.Y. *Integrated system test of the advanced instructional system (AIS).* AFHRL-TR-79-40, AD-A081 854.

Lintz, L.M., Tate, T., Pflasterer, D.C., Nix, C.J., Klem, T.G., & Click, L.E. *Low-cost computer-aided instruction/computer-managed instruction (CAI/CMI) system: Feasibility study.* AFHRL-TR-79-42, AD-A081 072.

Lobel, A.E., & Mulligan, J.F. *Maintenance task identification and analysis: Organizational and intermediate maintenance.* AFHRL-TR-79-50, AD-A083 685.

Looper, L.T., & Beswick, C.A. *Recruiting resource and goal allocation decision model.* AFHRL-TR-79-55, AD-A080 747.

Marcus, G.H., Patterson, J.T., Bennett, C.D., & Gershan, B.S. *Cost-effectiveness methodology for aircrew training devices: Model development and users handbook.* AFHRL-TR-79-39, AD-B044 765L.

Martin, E.L., & Cataneo, D.F. *Computer generated image: Relative training effectiveness of day versus night visual scenes.* AFHRL-TR-79-56, AD-A088 313.

Massey, R.H., & Mathews, J.J. *Reading grade levels of Air Force civilian personnel.* AFHRL-TR-80-11, AD-A087 066.

Micalizzi, J., Coward, R.E., & Nelson, W.H. *Simulator training effectiveness as a function of error counts on the F-15A flight simulator instructor operator station.* AFHRL-TR-79-48, AD-A081 074.

Montgomery, A.D., & Judd, W.A. *Computer-assisted instruction in the context of the advanced instructional system: Authoring support software.* AFHRL-TR-79-12, AD-A081 071.

Moore, M.H., Anderson, N.D., Adams, T.A., & Looper, L.T. *Markov resource utilization decision aid for Air Force recruiting service.* AFHRL-TR-80-4, AD-A083 194.

Mulligan, J.F. *Logic tree troubleshooting aids: Organizational and intermediate maintenance.* AFHRL-TR-79-49, AD-A079 777.

Mulligan, J.F., & Bird, J.B. *Guidance for maintenance task identification and analysis: Organizational and intermediate maintenance.* AFHRL-TR-80-21, AD-A089 918.

Mullins, C.J., Earles, J.A., & Wilbourn, J.M. *Calculation of predictor composites in the absence of a criterion.* AFHRL-TR-79-53, AD-A080 921.

Nataupsky, M., Waag, W.L., Weyer, D.C., McFadden, R.W., & McDowell, E. *Platform motion contributions to simulator training effectiveness: Study III — Interaction of motion with field-of-view.* AFHRL-TR-79-25, AD-A078 426.

Nix, C.J., Tate, T., Dutka, S.C., Montgomery, H.L., Showers, D.P., Klem, T.G., & Marshall, A.P. *Low-cost technical alternative for learning center managers.* AFHRL-TR-79-77, AD-A082 343.

Plans and Programs Office. *Fiscal year 1981 — Air Force technical objective document.* AFHRL-TR-79-69, AD-A080 628.

Purifoy, G.R., Jr., & Benson, E.W. *Maintenance training simulators design and acquisition: Summary of current procedures.* AFHRL-TR-79-23, AD-A079 636.

Ree, M.J., & Jensen, H.E. *Item characteristic curve parameters: Effects of sample size on linear equating.* AFHRL-TR-79-70, AD-A082 341.

Sauer, D.W., Deem, R.N., & Askren, W.B. *Expert estimate method of generating maintenance and manpower data for proposed Air Force systems: Evaluation.* AFHRL-TR-79-79, AD-A082 994.

Sauer, D.W., Deem, R.N., & Askren, W.B. *Expert estimate method of generating maintenance and manpower data for proposed Air Force systems: Users guide.* AFHRL-TR-79-80, AD-A082 992.

Saving, T.R., Battalio, R.C., De Vany, A.S., Dwyer, G.P., & Kagel, J.K. *Air Force enlisted personnel retention-accession model.* AFHRL-TR-80-12, AD-085 658.

Skinner, M.J., & Alley, W.E. *Performance of retrained airmen in Air Force Technical Schools.* AFHRL-TR-80-7, AD-A090 535.

Thomas, E.L., & Hankins, R.J. *Use of human resources data in weapon system design: Identification of data/data systems and related technology.* AFHRL-TR-79-36, AD-A080 598.

Adkins, C.J. Jr., Morgan, B.B. Jr., & Alluisi, E.A. Information processing in a binary classification task. *Perceptual and Motor Skills*, 1979, **48**, 851-861.

Alluisi, E.A. Summary and synthesis of the human motivation, attitudes, error/reliability workshop. In J.J. Kramer (Ed.), *The role of behavioral science in physical security* (NBS Special Publ. No. 480-38). Washington: Department of Commerce, National Bureau of Standards, December 1979.

Alluisi, E.A., Beisel, W.R., Morgan, B.B. Jr., & Caldwell, L.S. Effects of sandfly fever on isometric muscular strength, endurance, and recovery. *Journal of Motor Behavior*, 1980, **12**, 1-11.

Askren, W.B., & Eckstrand, G.A. Human resource considerations from concept through deployment. *Defense Management Journal*, Second Quarter, 1980.

Berry, G., Harris, D., & Koonce, J. The use of personality characteristics as predictors of psychomotor performance. *Proceedings of the 7th Symposium on Psychology in the DOD*, 1980.

Berry, G., Hughes, R., & Jackson, L. Sex and handedness in simple and integrated task performance. *Perceptual and Motor Skills*, December 1980, *51*(3).

Buckland, G.H. Flight simulator runway visual textural cues for landing. *Proceedings, 24th Annual Meeting of the Human Factors Society*, October 1980.

Cassidy, M.J., Ruck, H.W., & Offutt, S.V. Task selection for job proficiency and training. *Proceedings, 21st Annual Conference of the Military Testing Association*, October 1979.

Chiles, W.D., & Alluisi, E.A. On the specification of operator or occupational workload with performance-measurement methods. *Human Factors*, 1979, **21**, 515-528.

Chiles, W.D., Jennings, A.E., & Alluisi, E.A. Measurement and scaling of workload in complex performance. *Aviation, Space, and Environmental Medicine*, 1979, **50**, 376-381.

Coward, R.E., Kellogg, R., & Castore, C. Which way is up?. *TAC ATTACK*, September 1979.

Coward, R.E., Moore, S., & Meshier, C. The good stick index - a performance measurement for air combat training. (accepted for publication in *Defense Management Journal*).

Coward, R.E., Moore, S., & Meshier, C. The good stick index - a performance measurement for air combat training. *Proceedings, First Interservice/Industry Training Equipment Conference*, November 1979.

Cream, B.W., & Eggemeier, F.T. Effectiveness, utilization, costs and considerations pertaining to the use of simulators for aircrew training. *Proceedings of the Society of Automotive Engineers*, February 1980.

Czuchry, J.A., Doyle, K.M., Fruch, J.T., Baran, H.A. & Dieterly, D.L. Digital avionics information system (DAIS): Training requirements analysis model (TRAMOD). *JSAS Catalog of Selected Documents in Psychology*, 9, November 1979.

Deignan, G.M., & Circchinelli, L.F. Simulation training in the "real" world(s): Some issues and empirical answers. *Proceedings of the 7th Symposium on Psychology in DoD*, April 1980.

Deignan, G.M., Seager, B.R., Kimball, M., & Harowitz, N.S. Comparative evaluation of computer-assisted, programmed text and lecture modes of instruction in three medical courses. *Proceedings of the 7th Symposium on Psychology in DoD*, April 1980.

Deignan, G.M., & Duncan, R.E. CAI in three medical courses: It was effective. *Behavior Research Methods and Instrumentation*, 1979, **10**, 228-231.

Finstuen, K., & Campbell, M.E. Further comments on Bartko's "On various intraclass correlation reliability coefficients." *Psychological Reports*, 1979, **45**, 375-380.

Giorgia, M.J., & Carpenter, J.B. Relative time-spent scales—another look at performance measures. *Proceedings, 21st Annual Conference of the Military Testing Association*, October 1979.

Guinn, N., Kantor, J.E., & Vitola, B.M. Effectiveness of adaptability screening. *Catalog of Selected Documents in Psychology*, **10**, 71, August 1980.

Hughes, R. Combat training simulation: Perspectives and views. *Proceedings, 1st Interservice/Industry Training Equipment Conference*, 1979.

Kantor, J.E., Guinn, N., & Vitola, B.M. Attitudinal correlates of course attrition level and student gender in Air Force technical training. *Catalog of Selected Documents in Psychology*, 9, 93, November 1979.

Kellogg, R.S. Psychophysiological effects of training in a full vision simulator. *Proceedings, 1980 Aerospace Medical Association Meeting*, May 1980.

Kellogg, R.S. Simulated A-10 combat environment. *Proceedings, 24th Annual Meeting of the Human Factors Society*, October 1980.

Koonce, J., & Berry, G. Comparison of males and females in the prediction of basic flight performance. *Proceedings of the 7th Symposium on Psychology in DoD*, 1980.

Loeb, M., & Alluisi, E.A. Theories of vigilance: A modern perspective. *Proceedings, 24th Annual Meeting of the Human Factors Society*, October 1980.

Longridge, T.M. An evaluation of alternative HUD symbologies for the A-10 aircraft. *Proceedings, 23rd Annual Meeting of the Human Factors Society*, October 1979.

Longridge, T.M. & Zeidman, K. Measurement of perceptual workload and scanning. *Proceedings, 24th Annual Meeting of the Human Factors Society*, October 1980.

Ogden, G.D., & Alluisi, E. A. Stimulus-response compatibility effects in choice reactions and memory scanning. *Journal of Experimental Psychology: Human Learning and Memory*, 1980, 6, 430-438.

Pierce, B.J., DeMaio, J., & Yates, D. Validation of an in-flight performance measurement methodology: F-4 ground attack training evaluation. *Proceedings, 23rd Annual Meeting of the Human Factors Society*, October 1979.

Ree, M.J. AVRAM: Adaptive vector and response automation method. *Applied Psychological Measurement*, 1980, 3, 227-228.

Ruck, H.W. Officer job analysis: Is the enlisted model appropriate? *Proceedings, 21st Annual Conference of the Military Testing Association*, October 1979.

Schipper, L.S. & Rucci, A.J. Estimation of likelihoods of events as a function of impact and reliability of predictors. *Proceedings, Psychonomic Society, 19th Annual Meeting*, November 1978.

Stephenson, R.W. Development plans for an Air Force occupational research data bank. *Proceedings of the 21st Annual Conference of the Military Testing Association*, October 1979.

Stephenson, R.W. & Stephenson, M.K. Design requirements for a planning information system for training and personnel technology RDT&E. *Information Processing and Management*, 1980, 16, 169-173.

Thew, M.C., & Weissmuller, J.J. CODAP: A current overview. *Proceedings, 22nd Annual Conference of Military Testing Association*, October 1980.

Thompson, N.A., & Ruck, H.W. A comparison of safety training and other vocational training requirements. *Proceedings, 21st Annual Conference of the Military Testing Association*, October 1979.

Titsworth, W.L. Differences between crosstrainees and non-crosstrainees on grade level, job satisfaction and assignment characteristics. *Catalog of Selected Documents in Psychology*, 1979, 9, 95.

Vestewig, R.E., & Eggemeier, F.T. Actual vs simulated equipment for aircraft maintenance training: Cost implications of the incremental vs the unique device. *Proceedings, 23rd Annual Meeting of the Human Factors Society*, October 1979.

Weaver, C.N. Job satisfaction in the United States in the 1970's. *Journal of Applied Psychology*, June 1980.

Weaver, C.N. Worker expectations about losing and replacing their jobs. *Monthly Labor Review*, April 1980.

Weissmuller, J.J. CODAP: Multiple clustering application. *Proceedings, 21st Annual Conference of Military Testing Association*, October 1979.

Weissmuller, J.J. CODAP: Multiple clustering application. *Proceedings, 22nd Annual Conference of Military Testing Association*, October 1980.

Wilbourn, J.M., & Alley, W.E. Pictorial interest inventory development. *Catalog of Selected Documents in Psychology*, 1980, 10, 71.

Adams, J.R., & Leonard, S. *Project management in the human services field.* International Seminar/ Symposium, Project Management Institute, Atlanta, GA, October 1979.

Alluisi, E.A., & Coates, G.D. *Dimensionality and S-R compatibility effects.* Human Factors Society, Boston, MA, November 1979.

Alluisi, E.A. (Chair). *Training Seminar: Uses of the PsycINFO data base.* American Psychological Association, 88th Annual Convention, Montreal, Canada, September 1980.

Alluisi, E.A., & Hoggatt, R.S. *Organization for applications and liaison at the Air Force Human Resources Laboratory.* In J. Hicks (Chair). *Applications of human research in the U.S. military: An update.* American Psychological Association, 88th Annual Convention, Montreal, Canada, September 1980.

Alluisi, E.A. *A history of military psychology: The Air Force Human Resources Laboratory.* Old Dominion University Conference on the History of Applied Psychology, Virginia Beach, VA, November 1980.

Askren, W.A. *Human resources and logistics factors in the design, modeling and life cycle costing of Air Force weapons systems.* Operations Research Society of America/The Institute of Management Sciences, Milwaukee, WI, October 1979.

Askren, W.A. *Human resources, logistics and cost factors in weapon system acquisition: A new methodology.* ASD/AIAA Mini-Symposium, Wright-Patterson AFB, OH, March 1980.

Bailey, J., Hughes, R., & Jones, W. *Application of backward chaining to air-to-surface weapons delivery training.* American Psychological Association, 87th Annual Convention, New York, NY, September 1979.

Baran, H.A. *Impact of design and support planning on personnel requirements and life cycle cost.* 21st Annual Conference of the Military Testing Association, San Diego, CA, October 1979.

Buckland, G.H. *Flight simulator runway visual textural cues for landing.* American Psychological Association, 87th Annual Convention, New York, NY, September 1979.

Buckland, G.H. *Visual cue requirements for terrain flight simulation.* American Psychological Association, 88th Annual Convention, Montreal, Canada, September 1980.

Burkett, J.R. *Air Force on-the-job training R&D.* Military Airlift Command On-the-Job Training Workshop, Scott AFB, IL, July 1980.

Burkett, J.R. *Air Force literacy and basic skills research and development.* Meeting of the Joint Services Basic Skills/Literacy Working Group, Fort Meyer, VA, September 1980.

Burkett, J.R., & Hooke, L.R. *Analysis of the functional literacy requirements of Air Force jobs.* American Psychological Association, 88th Annual Convention, Montreal, Canada, September 1980.

Cassidy, M.J. *Using occupational survey data in on-the-job training.* Third International Occupational Analyst Conference, Randolph AFB, TX, May 1980.

Cummings, W.H. *Rater accuracy in predictions of ability.* Seventh Symposium on Psychology in the DoD, USAF Academy, April 1980.

Datko, L.M. *Comparison of clerical classification.* Third International Occupational Analyst Conference, Randolph AFB, TX, May 1980.

Deignan, G.M., Seager, B.R., Kimball, M., & Harowitz, N.S. *For whom are CAI programmed test and lecture effective?* American Psychological Association, 88th Annual Convention, Montreal, Canada, September 1980.

DeLeo, P.J. *On-the-job training capacity research.* Air Force On-the-Job Training Steering Committee, Gunter AFB, AL, October 1979.

Eddowes, E.E. *Skills maintenance and reacquisition training (Project SMART) research report.* American Psychological Association, 87th Annual Convention, New York, NY, September 1979.

Gott, S.P. *Survey assessment of strength and stamina job requirements.* Third International Occupational Analyst Conference, Randolph AFB, TX, May 1980.

Gould, R.B. *Pilot selection research: A status report.* Seventh Symposium on Psychology in the DoD, USAF Academy, April 1980.

Guerrieri, J.A. *Job performance evaluation pilot testing: Lessons learned.* Showcase of Agency Performance Appraisal Systems, Washington DC, January 1980.

Guerrieri, J.A., Cowan, D., & Vitola, B. *Conceptual model of a merit pay appraisal system for Air Force civilian employees.* Seventh Symposium on Psychology in the DoD, USAF Academy, April 1980.

Hooke, L.H. *Readability of Air Force publications.* Seventh Symposium on Psychology in the DoD, USAF Academy, CO, April 1980.

Hughes, R.G., & Jones, W. *Advanced training features: Alternative applications of an automated record/playback feature.* American Psychological Association, 87th Annual Convention, New York, NY, September 1979.

Hughes, R. *On the training effectiveness of color for military flight training simulation: A symposium* (Chair). 1st Interservice/Industry Training Equipment Conference, Orlando, FL, November 1979.

Ideen, D.R., & Kantor, J.E. *The impact of stress on performance in the air combat environment.* Seventh Symposium on Psychology in the DoD, USAF Academy, CO, April 1980.

Kantor, J.E., & Ideen, D.R. *The Air Force female pilots program: An interim report.* 21st Annual Convention of the Military Testing Association, San Diego, CA, October 1979.

Kantor, J.E. *Research on women in combat related roles.* TIMS/ORSA Joint Meeting, Washington, DC, May 1980.

Loeb, M., & Alluisi, E.A. *Theories of vigilance: A modern perspective.* Human Factors Society, Los Angeles, CA, October 1980.

Maher, F.A., & Asiala, C. *Development of maintenance resources interaction.* Operations Research Society of America/The Institute of Management Sciences, Milwaukee, WI, October 1979.

Malmstrom, F.V., & Reed, L.E. *Saccadic and pursuit eye movements during a concurrent secondary task.* American Psychological Association, 88th Annual Convention, Montreal, Canada, September 1980.

Needham, R.C., Edwards, B.J., & Prather, D.C. *Trends in Air Force simulation: Perspectives from the Air Force Human Resources Laboratory, Operations Training Division.* National Security Industrial Association Training Symposium, San Antonio, TX, April 1980.

O'Connor, T.J. *How reliable are technical surveys?* American Psychological Association, 88th Annual Convention, Montreal, Canada, September 1980.

Phalen, W.J., Thew, M.C., & Weissmuller, J.J. *Workshop on CODAP systems & applications.* 4th Annual Conference of the International Personnel Management Association Assessment Council (PIMAAC), Boston, MA, July 1980.

Phalen, W.J., Thew, M.C., & Weissmuller, J.J. *CODAP Workshop—Air Force applications.* 4th Annual Conference of the International Personnel Management Association Assessment Council, Boston, MA, July 1980.

Phalen, W.J. *Computer-Based Job Analysis: Some Innovative Applications to Personnel Management.* 4th Annual Conference of the International Personnel Management Association Assessment Council, Boston, MA, July 1980.

Ree, M.J. *The effects of errors in estimation of item characteristic curve parameters.* 21st Annual Convention of the Military Testing Association, San Diego, CA, October 1979.

Ruck, H.W. *A cross-company study of decision policies of manager resume evaluation.* Unpublished Doctoral Dissertation, Management Science Department, Stevens Institute of Technology, Hoboken, NJ, April 1980.

Smith, J.F. *History of USAF training research simulation.* AFOSR Sponsored 1980 Review of Air Force Sponsored Basic Research, March 1980.

Stephenson, R.W. *Development plans for an Air Force occupational research data bank.* 21st Annual Conference of the Military Testing Association, San Diego, CA, October 1979.

Stephenson, R.W., & Stephenson, M.K. *Design requirements for a planning information system for training and personnel technology RDT&E.* Seventh Symposium on Psychology in the DoD, USAF Academy, CO, April, 1980.

Stephenson, R.W., & Stephenson, M. K. *Design requirements for an investment strategy decision system for training personnel technology RDT&E.* ONR-sponsored conference on Multiple Criterion Decision Making, University of Delaware, Newark, DE, August 1980.

Tauscher, L.J. *Use of occupational data and methodology for technical training research.* 3rd International Occupational Analyst Workshop, San Antonio, TX, May 1980.

Thew, M.C. *CODAP: An exhibit and handout package of relevant materials.* 1980 Mid-Atlantic Technology Exchange Conference and Exposition. Baltimore, MD. March 1980.

Thompson, N.A., & Ruck, H.W. *The selection of tasks for vocational training.* American Psychological Association. 88th Annual Convention. Montreal, Canada. September 1980.

Tyndall, J.F. *COM in a personnel and training research environment.* 10th Annual COMTEC Conference. Atlanta, GA. February 1980.

Valentine, L.D., Jr. *Reading measurement research in the Air Force.* American Psychological Association. 88th Annual Convention. Montreal, Canada. August 1980.

Ward, J.H., Jr. *Policy specifying with application to personnel classification and assignment.* 21st Annual Convention of the Military Testing Association. San Diego, CA. October 1979.

Ward, J.H., Jr. *Interaction among people characteristics and job properties in differential classification.* 21st Annual Convention of the Military Testing Association. San Diego, CA. October 1979.

Watson, T.W., Guerrieri, J.A., & Earles, J.W. *Initial development of a job performance evaluation system (JPES) for Air Force civilian employees.* Seventh Symposium on Psychology in the DoD. USAF Academy. CO. April 1980.

Weeks, J.L., & Wissman, D.J. *The use of occupational survey data to develop measures of job difficulty.* Third International Occupational Analyst Conference. Randolph AFB, TX. May 1980.

Weeks, J.L. *Development of a longitudinal data base to study enlisted attrition, retention, and career development.* ORAS/TIMS Conference on Military Attrition. Milwaukee, WI. October 1979.

Weissmuller, J.J. & Thew, M.C. *CODAP workshop.* 1980 Occupational Analysts Conference. San Antonio, TX. May 1980.

CONFERENCES AND SYMPOSIA HOSTED BY AFHRL

June 1979 — December 1980	CODAP and Occupational Analysis Lecture Series. AFHRL. Brooks AFB. TX
June 1980	National Research Council Vision Committee Workshop on Visual Cue Requirements for Low Level Flight and Hostile Threat Environments. Williams AFB. AZ
March 1980	DOD Job Site Training Sub Technology Advisory Group. Lowry AFB. CO

Colonel Ronald W. Terry
Commander
AFHRL/CC
Brooks AFB TX 78235
(512) 536-2265
AUTOVON 240-2265

Colonel Kenneth E. Stout
Vice Commander
AFHRL/CV
Brooks AFB TX 78235
(512) 536-3605
AUTOVON 240-3605

Dr. Earl A. Alluisi
Chief Scientist
AFHRL/CCN
Brooks AFB TX 78235
(512) 536-3605
AUTOVON 240-3605

Colonel William C. DeBoe
Director, Applications & Liaison Office
AFHRL/AZ
Brooks AFB TX 78235
(512) 536-3426
AUTOVON 240-3426

Dr. Herbert J. Clark
Director, Plans & Programs Office
AFHRL/XR
Brooks AFB TX 78235
(512) 536-3611
AUTOVON 240-3611

Dr. Robert A. Bottenberg
Director, Analysis & Evaluation Office
AFHRL/OA
Brooks AFB TX 78235
(512) 536-3942
AUTOVON 240-3942

Colonel Tyree H. Newton
Chief, Manpower & Personnel Division
AFHRL/MO
Brooks AFB TX 78235
(512) 536-2244
AUTOVON 240-2244

Colonel Richard C. Needham
Chief, Operations Training Division
AFHRL/OT
Williams AFB AZ 85224
(602) 988-6561
AUTOVON 474-6561

Colonel Donald C. Tetmeyer
Chief, Logistics & Technical Training Division
AFHRL/LR
Wright-Patterson AFB OH 45433
(513) 255-6797
AUTOVON 785-6797

Lt Colonel Wendell Anderson
Chief, Technical Services Division
AFHRL/TS
Brooks AFB TX 78235
(512) 536-3841
AUTOVON 240-3841